A star (*) indicates that the Abstract deals with Apparatus and Instruments.

JUNE, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

2204. Geometrical Structure of Space and Electronic Atmospheres. G. Fournier. *Comptes Rendus,* 206. *pp.* 1097–1099, *April* 4, 1938.—A geometrical representation of the levels of an atom is given in terms of piles of cubes. G. C. McV.

2205. Nuclear Structure Models. C. F. v. Weizsäcker. *Naturwiss.* 26. *pp.* 209–217, *April* 8, *and pp.* 225–230, *April* 15, 1938.—A concise account is given of a number of recently proposed models of the atomic nucleus. These include (*a*) the simplest nuclei containing at least four particles; (*b*) the "droplet" model; (*c*) the Hartree approximation; (*d*) the α-particle model. Other points dealt with include (*a*) the mass defect, (*b*) isotopes, (*c*) nuclear spin, (*d*) magnetic moment, (*e*) electric quadripole moment, (*f*) nuclear isomerism. A. W.

2206. Nuclear Forces and the Magnetic Moments of the Neutron and the Proton. H. Fröhlich, W. Heitler and N. Kemmer. *Roy. Soc., Proc.* 166*A*. *pp.* 154–177, *May* 4, 1938.—An attempt is made to explain the properties of the nuclear particles proton and neutron by the hypothesis that these particles are capable of emitting a positive or negative "heavy electron" respectively with a rest mass m_0 between that of the proton and the electron. The existence of those particles has been made probable by cosmic-ray observations. The heavy electrons are assumed to have integral spin and satisfy Bose statistics. The wave functions of these particles are assumed to be of vectorial character, the components of which satisfy the Klein-Gordon equation. They are quantised according to the scheme given by Pauli and Weisskopf. Thus, a free heavy electron can exist in three different states of polarisation; there are two transverse and one longitudinal wave with given momentum. The interaction with the nuclear particles is found by relativistic arguments and contains—apart from the mass m_0—two arbitrary constants g and f, both with dimensions of an electric charge. With this scheme the authors have calculated: (1) The neutron-proton force. It is an exchange force and has a range $1/\lambda = h/m_0c$. In the ^{3}S-state the force is always attractive. (This would not be the case for a scalar wave function.) g and f can be chosen so that the ^{3}S and ^{1}S-states have the right position. The experiments suggest $g \doteqdot f \doteqdot 5$ electron charges. (2) The magnetic moments μ_P and μ_N of the proton and neutron. They are found to be of nuclear dimensions and have the right sign. (3) The mass m_0 can be determined independently from the range of the neutron-proton force and from the magnetic moments. In both ways the authors find $m_0 \doteqdot 100$ electron masses. (4) The proton-proton force is obtained only in the fourth order of approximation and leads to a strong repulsion for distances less than $1/(2\lambda)$. Attraction and equality with the neutron-proton force could be attained by introducing also neutral particles with mass m_0. (5) The theory leads to a diverging self-energy of the proton and neutron. [See Abstract 1760 (1938).] AUTHORS.

2207. Isotopic Constitution of Gadolinium, Dysprosium, Erbium and Ytterbium. A. J. Dempster. *Phys. Rev.* 53. *pp.* 727–728, *May* 1, 1938.—The mass spectra of four rare-earth elements have been photographed, by the use of a spark source for the ions. New faint isotopes have been found in all four. The mass numbers of the new isotopes and rough estimates of their abundance in percent are: Gd, 154 (1·5), 152 (0·2); Dy, 160 (1·5), 158 (0·1); Er, 164 (2), 162 (0·25); Yb, 170 (2), 168 (0·06). AUTHOR.

2208. Separation of Gaseous Isotopes by Diffusion. R. Sherr. *J. Chem. Phys.* 6. *pp.* 251–259, *May*, 1938.—The behaviour of a set of mercury diffusion pumps is investigated and the separation factors for a number of isotopic mixtures are determined. Formulæ are derived which give the dependence of enrichment on the choice of reservoirs. In addition, Barwich's theory for the fractionation process has been extended to the case of finite reservoirs. The solution for this problem is a slowly converging series, but a qualitative picture of the dependence of equilibrium time on various factors is obtained. The separation factors which have been found for the Hertz diffusion pumps for Br_2 in CH_3Br, C in CH_4, oxygen in O_2 and H_2O, Ne, and A are 1·005, 1·107, 1·045, 1·073, 1·198 and 1·154 per unit, respectively. Twelve pumps of the Hertz design, and seventeen modified units were used. The modifications were made in an attempt to improve the original design, but the factors obtained for these units are smaller. Auxiliary experiments indicate that the performance of the new units is seriously impaired by the presence of back diffusion and that increased factors can be obtained by eliminating the latter effect. AUTHOR.

2209. Structure of Tetraborane B_4H_{10} and the Pentaborane B_5H_{11}. S. H. Bauer. *Am. Chem. Soc., J.* 60. *pp.* 805–812, *April*, 1938. An electron diffraction investigation of tetraborane and the pentaborane B_5H_{11} led to the following conclusions. B_4H_{10} has a configuration analogous to butane; the B-B distance is equal to 1·84 ± 0·04 Å and B-H = 1·28 ± 0·03 Å. The structure of B_5H_{11} is similar to that of either pentane or isopentane (the location of the trivalent B atom cannot be determined); the mean B-B separation is 1·81 ± 0·03 Å and B-H = 1·26 ± 0·03 Å. In both cases the valence angles are close to tetrahedral and internal rotation must be assumed. The implications suggested by the observed distances with regard to the electronic configuration of the respective molecules are discussed briefly and it is pointed out that the structural data as well as chemical evidence clearly place diborane with the compounds of the $B_n H_{n+6}$ group. A set of rules, some of qualitative nature, is deduced to help formulate the constitution of the hydrides of B. AUTHOR.

2210. Structural Formulæ of Unsaturated Hydrocarbons. M. Brutzcus. *Comptes Rendus*, 206. *pp.* 1177–1179, *April* 11, 1938.—The conversion of divalent to tetravalent C is accompanied by absorption of 102·72 kg.cal. per gm. atom. Thus the combustion of a gram atom of divalent C in a hydrocarbon evolves 102·72 kg.cal. less than the same amount of tetravalent C. It is hence inferred that there are no such things as double and treble bonds, those merely being the representation of the presence of one or two divalent atoms of C in the molecule respectively. Thus C_2H_4 is not $H_2C:CH_2$, but HC′Me; C_2H_2 is not HC:CH, but HC′·C′H (where C′ is a divalent atom of C). [See also Abstract 2080 (1938).] C. A. S.

2211. Theory of Rotational Transformation. G. Hettner. *Ann. d. Physik*, 32. 1–2. *pp.* 141–147, *May*, 1938.—The results on the transformation shown by solid HCl at 99° Abs. [see Abstract 835 (1938)] are discussed. The transformation does not appear to be one in which there is a transition from vibration to rotation of the molecules. Rather the β-state behaves, as far as rotation of molecules is concerned, like a liquid with a high internal field. The difference between the position and motion of the molecules in the α- and β-states is rather like that which exists in general between the solid and liquid states. A. J. M.

2212. Stability of Free Radicals. C. E. H. Bawn. *Faraday Soc., Trans.* 34. *pp.* 598–607, *May,* 1938.—The mechanism of the decomposition of the ethyl, propyl and acetyl radicals is discussed and the activation energy of the decomposition reactions computed. AUTHOR.

2213. Trimethylene Biradical. C. E. H. Bawn and R. F. Hunter. *Faraday Soc., Trans.* 34. *pp.* 608–613, *May,* 1938.—The trimethylene biradical prepared by interaction of trimethylene bromide with atomic Na gives rise to a mixture of *cyclo*propane and propylene. The latter is formed by a heterogeneous reaction of the biradical. The mechanism of the chemiluminescence which accompanies the reaction between trimethylene bromide and atomic Na is discussed. AUTHORS.

2214. Eighth Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, O. Hönigschmid and P. LeBeau. *Am. Chem. Soc., J.* 60. *pp.* 737–745, *April,* 1938.—The atomic weights that have been revised are: H from 1·0078 to 1·0081, He from 4·002 to 4·003, C from 12·01 to 12·010 (though physical evidence seems to imply that 12·011 may be more correct), Mo from 96·0 to 95·95, Er from 167·64 to 167·2, W from 184·0 to 183·92, and Os from 191·5 to 190·2. The atomic weights of several varieties of radioactive Pb are discussed [see Abstract 2316 (1937)], and it is considered that that of Ra should probably be raised by 0·01–0·02. [See Abstract 1425 (1937).] C. A. S.

See also Abstracts 2524, 2618.

COLLOIDS.

2215. Light Scattering by Rubber Sols in Media of Different Polarities. V. Margaritov and B. Kovarskaia. *Acta Physicochimica,* 8. 3. *pp.* 279–289, 1938. *In English.*—The variation of the intensity of scattered light with the concentration of rubber sols is studied in different solvents. It is shown that upon transition to the higher members of the hydrocarbon series, the turbidity I_1 of rubber sols decreases. It has been ascertained experimentally that the variation of $1/I_1$ with the dilution of sols is linear. AUTHORS.

***2216. New Light Source for Photographic Ultramicroscopy. K. Hoffmann.** *Kolloid Zeits.* 83. *pp.* 9–13, *April,* 1938.—A description is given of a new arrangement for photographic ultramicroscopy whereby, using exposure times of 0·1 sec. and less, good pictures of liquid sols in Brownian movement can be obtained. The source of light is an Osram Hg lamp, which is very highly overloaded for a short time so that its surface intensity is greatly increased. The arrangement makes it possible for the first time to obtain successful ultramicroscopic photographs of hydrosols. Examples are reproduced. L. A. W.

2217. Viscosity of Lyophilic Vaseline Colloid in Sodium Oleate Solution. C. Rossi. *Gazz. Chim. Ital.* 68. 1. *pp.* 3–20, *Jan.,* 1938.—Viscosity measurements in a Couette apparatus at different velocities on vaseline particles 1·80–1·85μ in diameter, in aqueous 3% Na-oleate solutions at pH 8·9 and 9·3 are reported. Further experiments at different angular velocities on three 50% emulsions with particles of varying size, show that the latter has little influence on the magnitude of $\eta\infty$; the limiting value, however, is not attained so rapidly with increasing Ω, in the case of larger particles. The importance of the lyophilic mantle surrounding the particle is confirmed, but its action is less marked at high velocities, *i.e.*, when the zone in the immediate vicinity of the particle is affected. Within the compositions (10–50% by volume of disperse phase) and velocities studied, the equation $\pi = \pi_\infty + K(1 - e^{-a\Omega})/\Omega$ is valid. At high velocities, pH or other chemical or physical factors seem to have little effect on deformation, which is then governed by the solvent mantle; in the case of lyophilic colloids this is strongly adherent and stable. D. R. H.

2218. Agglomeration and Viscosity in Dilute Suspensions. G. Broughton and C. S. Windebank. *Indust. and Engin. Chem.* 30. *pp.* 407–409, *April*, 1938.—Experiments with suspensions of spherical glass and kaolin particles in an inert, organic mixture of equal density, in which marked agglomeration of particles was observable, indicate that the Einstein relation, $\eta = \eta(1 + 2{\cdot}5V)$ holds only for spheres of relatively large size (50–200μ) at low concentrations. The results show that conclusions as to the volumetric relations in colloidal systems based on the use of the Einstein formula, even for spherical particles, can be grossly misleading unless absence of agglomeration is assured. AUTHORS.

2219. Thermomechanical Properties of Rubber Sols. V. Margaritov. *Acta Physicochimica*, 8. 3. *pp.* 271–278, 1938. *In English.*—The effect of the molecular nature of dispersion medium on the mechanical properties of rubber sols is investigated. The variation of the yield value of sols on cooling is studied in different solvents under the conditions in which the dispersion medium does not freeze. It is shown that sols with predominant volume solvation (*e.g.*, in CS_2) set to jelly at a temperature much higher than the freezing point of the pure dispersion medium. As to sols in higher hydrocarbons (nonane, octane) with advanced surface solvation, these form no gel on cooling. AUTHOR.

2220. Influence of Supersonic Waves on the Viscosity of Colloidal Solutions. H. Freundlich and D. W. Gillings. *Faraday Soc., Trans.* 34. *pp.* 649–660, *May*, 1938.—Supersonic waves can affect the viscosity of many colloidal solutions. In all cases in which they act they reduce the viscosity; and this viscosity was, in all cases so far examined, found to be anomalous, or structural. The mechanism of the viscosity reduction is not the same in all cases. In the main, the collapse of cavities was essential, as was found by the fact that there was no action of supersonics when irradiating under high external pressure. This was the case with solutions of gums, cotton yellow, and sodium stearate. In the case of gum tragacanth solutions, the viscosity increases after standing for a time after irradiation; this recovery is rapid in the case of gelatin. In cotton-yellow solutions irradiation caused a destruction of rod-shaped particles present in the original solutions; the reduction of viscosity was accompanied by a disappearance of streaming double refraction, and a corresponding change in the ultramicroscopic view. In sodium stearate solutions, the viscosity reduction was parallel with the appearance of a number of rod-shaped particles, better defined than those originally present, and a disappearance of the background of small particles. In gelatin and agar solutions the viscosity reduction was not entirely prevented by avoiding a collapse of cavities. Anomalous viscosity was not markedly affected by supersonics in V_2O_5 or benzopurpurin solutions. The normal viscosity of concentrated sodium oleate solutions is also unaffected by supersonics. AUTHORS.

2221. Effect of Supersonic Waves on Solutions of Highly Polymerised Substances. E. Thieme. *Phys. Zeits.* 39. *pp.* 384–390, *May* 1, 1938.—The effect of supersonic waves on the viscosity of solutions of gelatin, agar-agar, and gum arabic has been determined. The viscosity is decreased, the effect being greater the greater the amplitude of the waves. The decrease is dependent upon concentration, and passes through a maximum which is displaced towards the lower concentrations with increasing molecular weight and decreasing amplitude. The effect is greater the greater the molecular weight. The viscosity does not decrease exponentially with time of exposure to the waves, although this relationship is reached after long exposures. A. J. M.

2222. Ultracentrifugal Study of Gelatin. E. B. Sanigar, L. E. Krejci and E. O. Kraemer. *Am. Chem. Soc., J.* 60. *pp.* 757–763, *April,* 1938.—The sedimentation constants of four different brands of commercial gelatin in 0·4% solution at pH 7·5, measured at approximately 34°, vary between 2·60 and 3·30, compared with 3·43, the value found by Krishnamurti and Svedberg at 20° for a gelatin solution of the same concentration and pH, and 3·55, the constant for egg albumin, a normal globular protein of molecular weight 43,000. The sedimentation constants in the dilute solutions were found to increase regularly with the intrinsic viscosities. The sedimentation constants for the 2% solutions were found to be from 29 to 52% (average 41%) higher than for the dilute solutions; from the available data it is impossible to decide whether the increase is due to aggregation, or whether it is only apparent, the result of an overcorrection for viscosity. All the solutions were found to be heterogeneous, to various degrees, with respect to particle size. AUTHORS.

2223. Natural and Artificial Rubber: Elasticity of Long-Chain Molecules. H. Mark. *Nature,* 141. *pp.* 670–672, *April* 16, 1938.—The elasticity of soft rubber is based on the same fundamental effect as that of gases: the elastic properties of hard rubber are closely related to those of solid bodies. Soft rubber becomes heated by rapid extension and cools when rapidly relaxed: hard rubber behaves like normal solid crystals. All bodies with characteristic rubber-like elasticity are built up of long chain-like molecules. The properties of such molecules are investigated by applying the notions of Boltzmann's statistical theory. The contraction of an extended piece of rubber is not due to the action of thermal forces but to the thermal movement of single members in the different chain molecules. The theory of Guth is presented briefly and shown to be in agreement with experimental results obtained by Meyer, Ornstein, Hock, Thiessen and Kuhn. The proposed model needs further improvement along lines which are indicated. J. S. G. T.

2224. Isoelectric Point of Cellulose. Adsorption and Swelling. J. Gavoret. *Comptes Rendus,* 206. *pp.* 1299–1300, *May* 2, 1938.—The position of the isoelectric point of cellulose has been verified by determining the increase of resistance when a constant weight of purified cotton was placed in solutions of various pH (1·4–6·8) values between Pt electrodes. There is a maximum increase between pH 2·4 and 2·8. The relationship between conductivity and adsorption of ions is discussed. A. J. M.

2225. Micellar Structure of Cellulose. O. Kratky and F. Schoszberger. *Zeits. f. phys. Chem.* 39. *Abt.B.* 2. *pp.* 145–154, 1938.—The X-ray investigation of ramie fibres in which finely divided gold had been inserted, gave two new effects namely: Increment of the intensity of the usual cellulose interference bands by about 100% and also raising the interference intensity of the refractivity at the minimum angle by between 100% to 200% more. Whilst the Frey-Wyssling method gives results due to large faulty places in the micellar system which appear when filled with gold particles, the present method presents the disposition, etc., of single micelles as also the deposition of the gold particles in very fine distribution in space. If the gold is subsequently dissolved out all phenomena appear in a coarser structure than in the primary original. S. G. B.

2226. Structure of Hair, Wool and Related Fibres. Part IV. H. J. Woods. *Roy. Soc., Proc.* 166*A*. *pp.* 76–96, *May* 4, 1938.—The results seem to support the view that the fibre substance may be divided into three phases, or modifications of a fundamental keratin, which transform successively in the three ranges of extension (in dry air, cold water, and steam). These phases are K_1 which transforms most easily, and forms a continuous matrix (perhaps the intercellular medium) in which the others, K_2 (the most crystalline phase), and K_3 are embedded. Experiments are described showing that the cells apparently contain crystalline keratin and also K_1; but it is doubtful whether the intercellular material may be classed with the cuticle and medulla as of no importance as regards elastic behaviour. Two methods of investigation were used: the properties of the cells isolated by disintegration of the fibre were studied; and those of coherent films made from such cells. [For Part III see Abstract 3255 (1935).] C. A. S.

2227. Preparation, Properties and Particle Size of Mineral Suspensions, with Special Reference to Graphite. E. Hoffmann. *Kolloid Zeits.* 82. *pp.* 351–362, *March, and* 83. *pp.* 99–104, *April*, 1938.—A comprehensive review dealing with the methods of determining the particle size of suspensions of mineral substances, the theoretical basis of the formation of suspensions, the mechanism of their formation, the properties of suspensions of graphite and the effect of stabilisers. The technical production of aquadag and oildag is also considered. A. J. M.

2228. Emulsoidal State of Binary Liquid Systems above the Critical Miscibility Temperature. J. Frenkel. *Acta Physicochimica*, 8. 3. *pp.* 261–270, 1938. *In English.*—Many binary liquid mixtures are—even above the critical miscibility temperature—emulsoidal systems. Under such conditions the critical temperature must be defined as the temperature for which the surface tension between the two saturated molecular solutions of different composition vanishes. If the interface remained plane the surface tension would become negative with a further increase of temperature. In reality it is maintained near the value zero by the gradual emulsification of the system, till the true (molecular) miscibility temperature is reached. AUTHOR.

2229. Properties of Dual Emulsions. D. F. Cheesman and A. King. *Faraday Soc., Trans.*, 34. *pp.* 594–598, *May*, 1938.—Dual emulsions of amyl alcohol and water have been prepared with a large variety of emulsifying agents. In nearly every case the phase volume ratio and the proportion of emulsifying agent have been identical for the oil-in-water and water-in-oil types. Similar dual emulsions have been prepared with kerosine and water. Evidence has been produced to prove that the unusual types of emulsion prepared, although often unstable, are true emulsions in which the emulsifying agent behaves in the normal manner. In consequence of this research, doubt must now be thrown upon the rule that a given emulsifying agent is capable of stabilising an emulsion of one type only. AUTHORS.

2230. Stability of Dispersions. J. C. Carruthers. *Faraday Soc., Trans.* 34. *pp.* 646–649, *May*, 1938.—It is pointed out that emulsifiable organic compounds are those of high molecular weight and high boiling-point, whilst those of small molecular weight are, in general, not emulsifiable in the absence of a chemical stabiliser. The behaviour of liquid droplets consisting of hexane and octadecane in different proportions indicates that the heavier constituent immobilises the surface molecules of hexane, thus permitting, presumably, of adsorption of anions to a much greater extent than is possible in the case of pure hexane droplets. Thus an emulsion can be obtained of droplets each of which contains as much as 90% hexane whilst no emulsion can be obtained with pure hexane. The behaviour exhibited by mixtures of hexane and decalin are in agreement with the views expressed above, these mixtures illustrating, at the same time, that the immobilised hexane molecules have a greater intrinsic capacity for adsorbing negative charges than the decalin molecules themselves. AUTHOR.

2231. Electrolysis of Colloidal Silver Solutions. M. Centnerszwer and J. Borowicz. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10*A*. *pp.* 530–545, *Nov.–Dec.*, 1937. *In German.*—Solutions of colloidal Ag were prepared in as pure a state as possible and electrolysed. The individual Ag particles contained 48×10^6 to 170×10^6 atoms. The number of electrical charges on these individual particles was calculated from the electrical conductivity of the solution. The number of charges is smaller than the number of Ag atoms in the particle, and was found to be 0·53 to 0·97 of that number. When the solution was electrolysed the passage of the Ag particles to the anode was confirmed. At the same time it was found that dendrites of Ag were formed at the kathode during the electrolysis. The deposition of metallic Ag at the kathode was explained as a consequence of the retardation of the colloidal Ag particles during their motion to the anode. F. J. B.

2232. Heat Content of Colloidal Gold. R. Fricke and F. R. Meyer. *Zeits. f. phys. Chem.* 181. *Abt.A.* 6. *pp.* 409–429, 1938.—Au preparations of various degrees of particle fineness were prepared by precipitation from alkaline solutions with H_2O_2 in the presence of gelatin. Precipitates prepared from solutions of unprotected colloidal Au and dried at 150° C. show a rapid crystallisation and a particle size of more than 100 Å. The finest Au precipitates show, in solution in ICl_3, a heat content about 1·1 kg.cal./gm. atom higher than coarse Au. By using X-ray examination, this Au of high energy content shows that lattice distortions may be disregarded and thus its increased heat content is to be related to its increased surface area. With the protected colloidal particles the surface area shows a linear relation to the heat content. The surface energy was found to be too low by 670 erg/cm². With unprotected colloids the particles show such a variation of size that only a slight difference in heat content is found between the various specimens. G. G.

See also Abstracts 2254, 2299.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2233. Lattice Energies of Alkali Iodides and the Electron Affinity of Iodine. A. N. Tandon. *Nat. Acad. Sci. India, Proc.* 7. 2–3. *pp.* 102–110, 1937.—By studying the dissociation equilibrium of the vapours at high temperatures, the lattice energies of KI and NaI have been determined to be 150·6 and 166·4 kg.cal., respectively. The same experimental arrangement, as described in the work on the electron affinity of chlorine by M. N. Saha and the author, has been utilised. By the application of the Born's cycle to the lattice energy determinations the electron affinity of iodine has been found to be 72·4 kg.cal. The results are in good agreement with the calculations made from Born's theory and other experimental data. AUTHOR.

2234. Indexing of Stereographically Projected Crystal Faces. H. Tertsch. *Zeits. f. Krist.* 99. 1. *pp.* 61–66, 1938.—A simpler method for graphical crystal calculations is considered, and applied to the determination of the elementary cell and the indexing of the reflecting planes. The most complicated case of a triclinic crystal is taken and the simplification compared with other methods is demonstrated. For crystals of higher symmetry the simplification is considerable. The paper is entirely theoretical. C. J. B. C.

2235. Densest Position of Homologous Bodies. H. Hancock. *Science*, 87. *pp.* 320–322, *April* 8, 1938.—The author outlines the method of procedure for solving the general problem which is stated as the analytic formulation of the condition for the densest lattice-formed position of congruent homologous bodies in space. The lattice derived from the theory may be described as a cubo-octahedron (the part of an octahedron contained in a cube). This figure has 12 vertices and 14 sides. At the 12 vertices a given sphere presses against 12 other spheres and each octahedron presses against 14 sides of the cubo-octahedron. Biological applications of the theory are mentioned. J. I.

2236. Order and Disorder in Alloys. H. A. Bethe. *J. of Applied Physics*, 9. *pp.* 244–251, *April*, 1938.—The author explains the physical meaning of superlattices in terms of the critical temperature (the transition temperature at which the superlattice ceases to be stable); where this is low or high the existence of both ordered and disordered states at ordinary temperatures, is alike impossible. Only in alloys where it lies between about 300° and 700° C., with corresponding annealing times of (say) one year and one second, can both be obtained. Results obtained from Bragg and Williams' original and modified theories are compared mathematically, together with the effect of some recent refinements, and Kirkwood's deduction of the former directly from statistical concepts [see Abstract 928 (1938)] is discussed. [See also Abstract 1788 (1938).] D. R. H.

2237. Superlattice Formation of the Type AB in Alloys with Applications to the Theory of Adsorption. T. S. Chang. *Cambridge Phil. Soc., Proc.* 34. *pp.* 224–237, *April*, 1938.—Calculations are made to investigate the behaviour of ordering near the critical temperature for alloys with a superlattice of the type AB for various compositions. No fluctuation among the sites of the same kind, which may lead to the possible existence of some other types of superlattice, say, AB_3, is considered. Results showing the change of ordering with T near T_c are plotted. The theory is also applied to the adsorption of gases upon a solid surface, where the sites of accommodation are regularly arranged. It is shown that under certain conditions, a superlattice formation in the adsorbed layer is possible. AUTHOR.

2238. Nuclear Formation in the Separation of Metallic Mixed Crystals. R. Becker. *Ann. d. Physik*, 32. 1–2. *pp*. 128–140, *May*, 1938.—Under the assumption that the energy of a mixed crystal may be calculated from the simple addition of vicinal unions, the author has evaluated the work of formation of crystal nuclei in the separation of mixed crystals from a supersaturated binary mixture. The same method has also enabled the abundance of nuclear formation to be estimated. A numerical example is worked out for a case of maximum nuclear formation, which is in satisfactory accord with experimental measurements on the velocity of separation. H. H. Ho.

2239. Structure of Sodium Metaborate $Na_3(B_3O_6)$. Ssu-Mien Fang. *Zeits. f. Krist.* 99. 1. *pp*. 1–8, 1938. *In English.*—The unit cell of sodium metaborate is rhombohedral with $R = 7 \cdot 22 \pm 0 \cdot 01$ Å and $\alpha = 111° \, 29'$, the density is $2 \cdot 464 \pm 0 \cdot 005$ gm./cm^3., and there are six molecules of $NaBO_2$ per unit cell. The space group is $D_{3d}^6 - R\bar{3}c$. The atomic positions are $(u, \frac{1}{2} - u, \frac{1}{4})\circlearrowleft$. The parameter values were $0 \cdot 696 \pm 0 \cdot 003$ for Na, $0 \cdot 362 \pm 0 \cdot 006$ for B, $0 \cdot 479 \pm 0 \cdot 006$ for O_I, and $0 \cdot 138 \pm 0 \cdot 006$ for O_{II}. All atoms are found lying in layers normal to the three-fold axis 3·23 Å apart. The B and O atoms are linked together to form ring-shaped radicals, $(B_3O_6)^{-3}$, consisting of three BO_3 triangles with shared corners. The average B–O distance is 1·36 Å and the average O–O distance 2·35 Å. Na has a coordination number of seven with an average Na–O distance of 2·53 Å. AUTHOR.

2240. Structure of $AgMnO_4$. K. Sasvári. *Zeits. f. Krist.* 99. 1. *pp*. 9–15, 1938.—The unit cell is monoclinic with the following dimensions, $a = 5 \cdot 665$ Å, $b = 8 \cdot 27$ Å, $c = 7 \cdot 127$ Å, $\beta = 92°29 \cdot 5'$; the space group is $C_{2h}^5 - P2_1/n$; 4 mol. per unit cell. The intensities of the various reflections are estimated from oscillation photographs and compared with the calculated values for a suggested structure. Good agreement is obtained for a deformed baryta structure and the coordinates of the atoms in the cell are listed. J. I.

2241. Structure of Caesium Chromate, Cs_2CrO_4. J. J. Miller. *Zeits. f. Krist.* 99. 1. *pp*. 32–37, 1938. *In English.*—Caesium chromate belongs to the space group V_h^{16} . . . Pmcn. The unit cell, containing four molecules of Cs_2CrO_4, has the dimensions: $a_0 = 6 \cdot 226$, $b_0 = 11 \cdot 135$, $c_0 = 8 \cdot 363$ Å. The density is 4·345. The four Cr atoms are in the special positions $\pm (\frac{1}{4}, u, v) \pm (\frac{1}{4}, \frac{1}{2} - u, v + \frac{1}{2})$ with $u = 30°$ and $v = -93°$. The eight Cs atoms are in two sets of similar special positions with $u_1 = 30°$, $v_1 = 116°$, $u_2 = -108°$, and $v_2 = -173°$. The sixteen O atoms occupy two sets of such special positions with $u_1 = 30°$, $v_1 = -24°$, $u_2 = -19°$, $v_2 = -116°$ and one set of general positions $\pm (x, y, z) \pm (\frac{1}{2} - x, y, z) \pm (x, \frac{1}{2} - y, z + \frac{1}{2}) \pm (\frac{1}{2} - x, \frac{1}{2} - y, z + \frac{1}{2})$ with $x = 14°$, $y = 54°$, and $z = -116°$. AUTHOR.

2242. Structure of Long-Chain Acids. G. Giacomello. *Accad. Lincei, Atti*, 27. *pp*. 101–108, *Feb.* 6, 1938.—X-ray data on long-chain acids are reviewed, and interpreted by the Patterson method of Fourier analysis. The results provide little new information but put the conclusions of other work on a firmer basis. C. J. B. C.

2243. Structure of Dental Enamel. M. Harders-Steinhäuser. *Kolloid Zeits.* 83. *pp*. 86–98, *April*, 1938.—A comprehensive survey is given of work on the examination of dental enamel by the polarising microscope.

The sign and amount of double refraction of the enamel under different conditions are related to structure and constitution. The results obtained by X-ray methods [see Abstracts 964 (1935) and 2509 (1936)] are summarised and are found to agree with the optical results as regards the constitution, orientation and size of the enamel crystallites. J. T.

2244. Rôle of Impurities in the Structure of Liquid Crystals. P. Gaubert. *Comptes Rendus*, 206. *pp.* 1030–1032, *March* 28, 1938.—Previous work [see Abstract 939 (1938)] is now continued whence it has been found that the crystalline substance found in anisotropic drops of *p*-azoxyanisole and of *p*-azoxyphenetole forms the grain of the nematic phase. The isolation of the substance is reported, and it is found to be much less birefringent than *p*-azoxyanisole; its properties are given in detail, and definite additions of it to liquid crystals are found to cause variations of texture. The behaviour of phloridzin on liquid crystal structure is also described. H. H. Ho.

2245. Continuum and Swarm Theories of the Nematic Phase. H. Zocher. *Ann. d. Physik*, 31. 7. *pp.* 570–578, *April*, 1938.—It is shown that the Bose swarm theory, which was proposed by Constein to explain certain phenomena of nematic substances, is not in accord with the continuum theory of mesophases, while the van Wyk addition for the behaviour of nematic bodies in the magnetic field in an extension of the continuum theory. The importance of the Zocher elasticity constants of the nematic phases is indicated, and the opinion refuted that their introduction is invalid. These constants are discussed with respect to those introduced by Oseen. The layers of *p*-acetoxy-benzalazin investigated by Tropper are not statistically isotropic, as assumed by Fürth and Sitte [see Abstract 4820 (1937)], but optically uniaxial with the optic axis perpendicular to the cell walls. It is shown that for the calculation of properties such as double refraction, dielectric constant, etc., the thermal fluctuations may be neglected in a first approximation. Phenomena such as scintillation and polarised turbidity, do not require for their explanation the assumption of swarm formation (*loc. cit.*) with complete parallel arrangement of molecules in the centre as at the boundary; but are produced by fluctuations of groups of molecules. The various criticisms of the author are examined by **R. Fürth** and **K. Sitte** (*ibid. pp.* 579–582) who reaffirm the correctness of their own viewpoint.
H. H. Ho.

2246. X-Ray Studies on Liquids: Inner Peak for Alcohols and Acids. W. C. Pierce and D. P. MacMillan. *Am. Chem. Soc., J.* 60. *pp.* 779–783, *April*, 1938.—It has been shown, by Fourier analysis, that the inner X-ray diffraction peak found for aliphatic liquid acids and alcohols is due to an atomic distribution not present in other liquids, such as the paraffins and esters. This distribution is explained on the basis of molecular clusters which are due to association by means of H-bridge formation so that there is in a cluster a plane rich in O atoms. This plane lies at right angles to the hydrocarbon chains. Neighbouring chains are roughly parallel to one another, just as in the paraffins. The theory is applied to the interpretation of the X-ray diffraction found by Stewart [see Abstract 179 (1929)] for the isomeric octyl alcohols, some of which give inner peaks while others do not.
AUTHORS.

2247. Theory of the Liquid State. H. G. Trieschmann. *Zeits. f. phys. Chem.* 39. *Abt.B.* 3–4. *pp.* 209–217, 1938.—A theory of the liquid state is required for the further progress of theoretical organic chemistry. This should be deduced from experimental material on simple systems, much of which is at present available, and from which the arrangement of molecules in liquids can be obtained. A. J. M.

2248. Crystal Growth on Calcite Surfaces. G. I. Finch and E. J. Whitmore. *Faraday Soc., Trans.* 34. *pp.* 640–645, *May,* 1938.—$NaNO_3$ crystals have been grown on surfaces of calcite. It has been found that such overgrowth experiments and electron diffraction examination lead to similar conclusions as to the structure of the surfaces. Where the calcite surfaces are of single crystal structure continuous with that of the main crystal, as shown by their electron diffraction patterns having well-developed Kikuchi-line systems, the $NaNO_3$ overgrowth crystals are orientated and continue as nearly as is possible the atomic arrangements of the underlying calcite crystal. On the other hand, on those calcite surfaces which after polishing yield diffuse halo patterns suggesting an amorphous state of the polish layer, the overgrowths are unorientated and in no wise continue the substrate structure. Hence these overgrowth crystal experiments afford independent confirmation of the deductions previously drawn from an electron diffraction examination of calcite surfaces, according to which the polish layer on surfaces in or near a cleavage plane is of single crystal structure integral with the main crystal as a result of an orientated re-crystallisation of the layer caused to flow during polishing; on surfaces steeply inclined to all cleavage plane directions, however, the flowed layer does not re-crystallise on cessation of the polishing action but solidifies into an amorphous film. AUTHORS.

2249. Photochemical Processes in Crystals. R. Hilsch and R. W. Pohl. *Ann. d. Physik,* 32. 1–2. *pp.* 155–160, *May,* 1938.—This paper is concerned with photochemical investigations on mixed crystals of KH and potassium halides. It is supposed that in such mixed crystals the photochemical process, which is alleged to operate only in the presence of KH, consists of the liberation of K atoms whose incorporation in the lattice produces the colour centres. The position of the first absorption maximum is given by $h = E - J + Q$, where E is the electron affinity of the anion, J is the ionisation work of the kation and Q is the Coulomb part of the lattice energy. It is shown that the values calculated for RbBr and RbH for the first maxima agree well with experiment. Further, other bands are accounted for by considering the fact that the neutral atoms produced by the electron transfer occurring in the photochemical process may not only be in the ground state but also in excited states. J. E.

See also Abstracts 2255, 2256, 2292, 2443, 2490, 2491, 2505, 2599, 2613, 2614, 2620.

DENSITY.

***2250. Density and Refractive Index of very Dilute, Aqueous Solutions of Strong Electrolytes. W. Prang.** *Ann. d. Physik,* 31. 8. *pp.* 681–713, *April,* 1938.—A description is given of a differential float method for determining small differences of density. In determining the density of very dilute solutions the accuracy obtainable corresponds to 4 or 5 units in the 8th decimal place. Measurements are carried out on solutions of NaCl, KCl, Na_2SO_4, $MgSO_4$, Na_2CO_3 and K_2CO_3 at concentrations ranging from 0·1 to 0·0007 *N.*, and the variation of σ (density difference of solution from water divided by the density of water and the volume concentration) with the square root of the volume concentration is discussed. Refractive indices are measured for solutions of Na_2SO_4, Na_2CO_3 and K_2CO_3 by an interferometric method. The results show that the equivalent refractions of the carbonates are not influenced by certain anomalies in the variation of σ with concentration. L. A. W.

DIFFUSION AND OSMOSIS.

2251. Diffusion and Viscosity in Binary Liquid Mixtures. H. Lemonde. *Ann. de Physique*, 9. *pp.* 539–644, *April*, 1938.—A detailed critical review under the heads.—1. Discussion of results obtained for diffusion from the practical and theoretical standpoint; relations between D, *m* (molecular weight), η and T for dilute solutions, in general $D\sqrt{m}$ = const. and $D\eta$ = const. 2. Thovert's method for determination of D, precautions necessary; viscometry by Ostwald's method. 3. D appears to be related to the vapour pressure and molecular structure of the solute, the viscosity of the solvent, and the mutual molecular affinity between them. 4. Tabulated values for D, η, and $D\eta$. The plot D-composition is, in general, parabolic; in homologous series, progressive deformation takes place. The decrease or increase of D is a measure of the mutual intermolecular action between the components. Certain anomalies (*e.g.* benzene-alcohol, benzene-hexane) are probably due to dissociation. 5. Study of a wide variety of mixtures shows that $D\eta$ = const. is only a limiting law; in concentrated solutions $D\eta$ is a function of D, in dilute solutions a function of η; the maximum value for $D\eta$ is obtained with the most viscous solvent. 6. $D\eta$, which has the dimensions of a force, may be considered as the motive force of diffusion. 7. A comparison of curves for D and for vapour pressure in the same series shows an inverse relation between them, the direction of variation of D can be foreseen, and hypotheses regarding the motive force of diffusion can be verified. 8. Certain anomalies (*e.g.*, alcohol-water) are discussed, especially in relation to other properties. 9. Possible applications. D. R. H.

2252. Dynamics of Certain Liquid Movements in Capillary Systems (Lloyd Effect). Wo. Ostwald and H. Erbring. *Kolloid Zeits.* 83. *pp.* 13–19, *April*, 1938.—When two vessels, one containing solution and the other containing solvent, are connected by a strip of filter paper enclosed in a tube to prevent loss by evaporation, the solvent migrates into the solution and a considerable difference of level is set up (Lloyd effect). The paper describes experimental observations on the effect. It increases with increased concentration of solution, length and fineness of filter paper, etc. The maximum difference of level remains constant for a time and then diminishes slowly. The mechanism of the effect is discussed and it is concluded that it is not explicable by reference to isothermal distillation or difference of surface tension. L. A. W.

2253. Diffusion Syphon. E. Manegold and K. Solf. *Kolloid Zeits.* 83. *pp.* 19–23, *April*, 1938.—When a syphon tube is filled with water and its two ends placed respectively in water and an aqueous solution, the levels of the two liquids being initially the same, the diffusion of the solute into the one limb disturbs the equilibrium with the result that the water level sinks and a difference of level is set up. The effect is considered theoretically for three different syphon arrangements (one symmetrical and two asymmetrical) and formulæ for the calculation of diffusion coefficients are derived. A rough experimental test shows that the observed difference of level is in agreement with the theory within the limits of experimental error. L. A. W.

2254. Process of Diffusion in a Centrifugal Field of Force. W. J. Archibald. *Phys. Rev.* 53. *pp.* 746–752, *May* 1, 1938.—The general

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equation for the settling of particles and molecules in a liquid suspension or ideal solution in a centrifuge has been solved for the case of a sector-shaped cell extending to the centre of the centrifuge. Curves are given which show the concentration at all points in the cell for different values of the time. AUTHOR.

ELASTICITY AND PLASTICITY.

2255. Theory of Crystal Deformation. A. Pistocchi. *Alluminio*, 7. *pp.* 3–13, *Jan.–Feb.*, 1938.—Laws governing interatomic bonding and some lattice concepts are reviewed from a physical standpoint, with particular reference to the elastic properties, homogeneity, anisotropy and elasticity of crystals. The mechanism of deformation is considered, especially in relation to the velocity of application of the force causing it. Contraction and expansion are discussed fundamentally as lattice phenomena, in order to deduce the factors which govern the rupture of materials, as observed macroscopically. Solid solutions and lattice inclusions are considered as modifying factors, and an attempt is made to explain rupture on the basis of fatigue. D. R. H.

2256. Influence of Rate of Loading on Yield Point and Ultimate Stress. C. F. Elam. *Roy. Soc., Proc.* 165*A. pp.* 568–592, *April* 27, 1938.—Load-extension curves for ingot iron, steels, Cu, and Al alloys (all of unstated composition) are determined in calibrated Buckton and autographic tensile machines, at different loading rates obtained by means of gearing. With a uniform method of testing, the rate of deformation determines the stress at which plastic yielding begins. At sufficiently slow rates there may be only one yield point, and no horizontal position on the curve. A high yield stress gives a longer yield, hence the rise in the yield point for fine grained material. The difference between steel and Al in regard to " jumping deformation," and the actual mechanism of yielding in iron and steel, are presented. Various theories of hardening of crystals by cold-work are discussed in relation to the results obtained; it appears that a certain minimum time of application of the load is necessary, before flow begins. Finally the author recommends that stress, strain, time and temperature should all be recorded in the tensile test. D. R. H.

2257. Coefficient of Compressibility of Solids. P. Guareschi. *Accad. Lincei, Atti*, 27. *pp.* 90–91, *Feb.* 6, 1938.—In a previous paper [see Abstract 1826 (1938)] an expression for the frequency of vibration of a molecule in a solid was derived; combining this with the Einstein equation for the frequency, it is found that the coefficient of compressibility is proportional to the molecular weight and to the fifth power of range of molecular action. Although there are some wide differences between the computed and experimental values agreement is generally satisfactory. C. J. B. C.

2258. Photoelastic Examination of Spatial Strain in Convergent Light. R. Hiltscher. *Forsch. IngWes.* 9. *pp.* 91–103, *March–April*, 1938.—The " freezing method," described by Oppel, of studying spatial strain in certain given directions is extended to the study of the strain in any direction by utilising the interference properties of a crystal plate. It is possible to obtain the orientation and magnitude of the principal normal strains and the three principal shear strains. The Mohr circles can be obtained without specifying an origin. H. J. H. S.

2259. Photoelastic Analysis of Stress Concentration for Beams in Pure Bending with a Central Hole. J. J. Ryan and L. J. Fischer. *Frank. Inst., J.* 225. *pp.* 513–526, *May*, 1938.—This paper presents a photoelastic study of the conditions of stress concentration about a hole in a beam subjected to pure bending. Rules for stress determination in beams of this type are suggested. AUTHOR.

2260. Asymptotic Formulæ Relating to Relaxation Oscillations. J. Haag. *Comptes Rendus*, 206. *pp.* 1235–1237, *April* 25, 1938.—Numerical values of arcs and periods relating to relaxation oscillations calculated by the asymptotic formulæ given in a previous note [see Abstract 2381 (1937)] are found to be in satisfactory agreement with values calculated by direct integration; the agreement in the case of the arcs is particularly satisfactory. J. S. G. T.

2261. Strain in Glass. Part II. N. Winter-Klein. *Rev. d'Optique*, 16. *pp.* 361–385, *Nov.*, 1937.—From a study of the passage of glass from the α- to the β-variety [see Abstract 1501 (1937)], it is concluded that there is a region rather than a point of transformation. Samples in each of the two varieties when heated to a chosen temperature each tend to the same state of equilibrium. A way of annealing is suggested to shorten the time of annealing. A temperature can be found at which the transformation takes place instantaneously. The indices of refraction corresponding with the various states have also been investigated. F. S.

See also Abstracts 2498, 2563.

GRAVITATION.

See Abstract 2290.

HYDRODYNAMICS AND AERODYNAMICS.

2262. Motion of Two Infinite Circular Cylinders in Rotating Fluids. M. Ray. *Calcutta Math. Soc., Bull.* 29. *pp.* 125–156, *Sept.–Dec.*, 1937.—Formulæ, necessarily long and complicated, are derived for the relative stream-function and for the forces on the cylinders, when two circular cylinders are in motion in a uniformly rotating inviscid incompressible fluid. The derivation proceeds by successive approximation from the formula for a single cylinder, by the addition of terms calculated to annul the normal velocity, due to the terms already calculated, at each cylinder in turn, the distance between the cylinders being supposed large compared with the radius of either. Certain constrained motions are considered (*e.g.* one cylinder forced to move in a circle). Results are also calculated when the undisturbed motion is a uniform shearing motion. S. G.

2263. Simple Derivation of Stresses in a Moving Fluid. R. N. Ghosh. *Nat. Acad. Sci. India, Proc.* 7. 2–3. *pp.* 88–94, 1937.—This note describes a simple method of deriving equations for internal forces in a fluid which is in relative motion, paying special attention to the physical principles involved. AUTHOR.

2264. Method of Establishing the Equations of Hydrodynamics. G. Dedebant, M. Kiveliovitch, and P. Wehrle. *Comptes Rendus*, 206. *pp.* 815–817, *March* 14, *and pp.* 981–983, *March* 28, 1938.—By assuming a distribution function for the velocities, and submitting it to certain integral conditions, it is shown that to a first approximation, the equations of motion of a perfect fluid result, while a second approximation leads to those of a viscous fluid. In the second note Kiveliovitch shows that the results do not depend on the form assumed for the distribution function.

W. G. B.

2265. Criterion for Occurrence of Alternating Vortices and Relaxation Oscillations. M. Teissié-Solier and L. Castagnetto. *Comptes Rendus*, 206. *pp.* 1279–1281, *May* 2, 1938.—Three regions are discriminated in the curves representing the damping of oscillations in the wake of a stream flowing past a cylinder of revolution, the conditions being in the neighbourhood of those which are critical for the production of alternating vortices. The critical conditions are studied by kinematography in the case of fluid flowing past a cylinder of 6 mm. dia. at 16·4° C. The value of the criterion deduced by the theory from these experiments, *viz.*, $R_e = 52$, differs only very slightly from that previously obtained by direct observation. J. S. G. T.

2266. Moment of Fluid Forces Acting on Plate Gliding on Surface of Stream. A. E. Green. *Cambridge Phil. Soc., Proc.* 34. *pp.* 167–184, *April*, 1938.—Formulæ have been obtained for the moment of the fluid forces which act on a plane plate which is gliding on the surface of a stream of finite or infinite depth. It has been shown that the formulæ for the lift and moment forces acting on a plate which is gliding on a stream of infinite depth may be obtained by a limiting process from the formulæ for the general case of gliding on a stream of finite depth. Also, by another limiting process, the lift and moment forces for the Rayleigh flow past a flat plate in an infinite stream have been obtained from the lift and moment forces for gliding on a stream of infinite depth. Numerical work has been carried out for the case when the angle of incidence of the plate to the stream is 5° and this has shown the variation of the lift and moment forces and the position of the centre of pressure with a range of values of the length of the plate, the depth of the stream and the height of the trailing edge of the plate above the bed of the stream. AUTHOR.

2267. Velocity and Temperature Distributions in Plane and Axially Symmetrical Jets. L. Howarth. *Cambridge Phil. Soc., Proc.* 34. *pp.* 185–203, *April*, 1938.—The calculations of the velocity and temperature distributions for the turbulent flow in axially symmetrical and plane jets are described. For axially symmetrical jets Tollmien's results derived from calculations based on the momentum theory are stated; the calculations on the basis of the modified vorticity transfer theory and on the vorticity transfer theory with symmetrical turbulence are carried out. Unfortunately it seems to be true that none of these theories provides results in good agreement with experiment for both the velocity and temperature distributions. For plane jets the results obtained by Tollmien and based on the momentum transfer theory are stated; the calculations on the basis of the vorticity transfer theory are carried out. The velocity distributions on both theories are identical and in fair agreement with experiment. In order to test the validity of the theories it is necessary to compare the theoretical results for the temperature with experiment. No results for the latter seem to have been published.

AUTHOR.

2268. Secondary Flow due to a Sphere Rotating in a Viscous Fluid. W. G. Bickley. *Phil. Mag.* 25. *pp.* 746–752, *May*, 1938.—A second approximation, based on the well-known solution of Stokes, is obtained. The inflow along the axis, and the equal outflow parallel to the equatorial plane, are determined, and the stream-lines of the secondary flow are exhibited. To the order of approximation obtained, there is no effect upon the retarding torque. W. G. B.

2269. Lift and Moment on a Flat Plate in a Stream of Finite Width. T. H. Havelock. *Roy. Soc., Proc.* **166***A*. *pp.* **178–196,** *May* **19, 1938.**—The paper gives a new treatment of the problem of a flat plate in a stream bounded by plane parallel walls, including circulation round the plate. The plate is considered as the limiting case of the elliptic cylinder; an integral equation is obtained, whose solution by continued approximation leads to expansions for the lift and moment on the plate. The solution is modified to give similar results when the stream is bounded by parallel free surfaces, taking the condition at a free surface in an approximate form; and a further modification gives the case when one boundary of the stream is a plane wall and the other is a free surface. The problem of the elliptic cylinder in general is also considered with reference to the moment of the forces when the stream is bounded by plane walls and when there is no circulation. AUTHOR.

2270. Turbulent Flow of a Fluid in a Straight Pipe of Annular Cross-Section. V. Mikrjukov. *Techn. Phys., U.S.S.R.* **4. 11–12.** *pp.* **961–977, 1937.** *In English.*—Turbulent flow of water in a straight conduit of length 4·3 m. of annular cross-section bounded by coaxial cylindrical seamless brass tubes of 4·5 cm. and 8·3 cm. dia. was studied. The range of Reynolds' number characterising the flow was 4×10^3 to 150×10^3. The distribution of velocities in the cross-section was asymmetrical. Frictional stress was approximately three times greater on the inner wall of the annulus than what it was on the outer wall. Prandtl's and Kármán's theory of turbulent flow is qualitatively applicable to explain the results; Kármán's universal constant, κ, has the value 0·24. J. S. G. T.

2271. Influence of Wall Oscillations, Wall Rotation and Entry Eddies on the Breakdown of Laminar Flow in an Annular Pipe. A. Fage. *Roy. Soc., Proc.* **165***A*. *pp.* **501–529,** *April* **27, 1938.**—Experiments are reported on the breakdown of laminar flow in four annular pipes, ratios of hydraulic mean depths m to external radius from 0·095 to 0·063. Various different entry systems were used to ensure that the conclusions were independent of entry conditions. The pressure drops down the pipes were measured under various conditions. (*a*) With the inner wall oscillating axially with amplitude A and frequency f (the outer wall being fixed), breakdown occurred at values of $4\pi A(\pi f/\nu)^{\frac{1}{2}}$ from 225 to 281 for various amplitudes in one pipe, the value being independent of $\bar{u}m/\nu$ in the range covered (ν = kinematic viscosity, $\bar{u}$ = average velocity), the range being 210 to 682 for one amplitude, and inside that range for the other amplitudes. (*b*) For angular oscillations of the inner wall about its axis, breakdown had not occurred at the values of $4\pi A(\pi f/\nu)$ in (*a*). Visual observation suggested the presence at breakdown of ring vortices, *i.e.*, of vortices with axes parallel to the direction of oscillation. (*c*) With the inner wall rotating with constant angular velocity ω, the critical values of $2\omega bm((a + b)/m)^{-\frac{1}{2}}/\nu$ increase with $\bar{u}\ m/\nu$ (a = external, b = internal radius). The extrapolated value for $\bar{u}\ m/\nu = 0$ agrees with G. I. Taylor's value. The values are considerably less than those calculated from Cornish's results. At a given $\bar{u}\ m/\nu$ the departure from the laminar pressure gradient with increasing angular velocity is at first very small. (*d*) The critical values of $\bar{u}\ m/\nu$ were found when eddies were introduced at the entry by means of grids. The lower critical value of $\bar{u}\ m/\nu$ found was about 600; early breakdown can be caused by quite weak entry disturbances when they

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are in the form of discrete eddies. (*e*) Theoretical formulæ are given for laminar flow under a pressure gradient with the inner wall oscillating axially. S. G.

2272. Liquid Jets at Supersonic Velocities. R. Kling and N. Manson. *Comptes Rendus*, 206. *pp.* 892–894, *March* 21, 1938.—The injection of liquids (volatile oils, alcohol, water, and glycerin) through a fine aperture is investigated by means of ultra-rapid shadow photography, which allows the appearance of the jet and the perturbations produced in the surrounding gaseous medium to be observed. The injection is effected by the fall of a weight from various heights *h* on to the head of a piston. Above a critical value of *h* the jet exceeds the velocity of sound as shown by Mach waves. Data on the influence of *h*, and the volume and nature of the liquid injected are reported. N. M. B.

See also Abstract 2542.

KINETIC THEORY OF MATTER.

2273. Error in Statistical Series of Observations with Application to Brownian Motion of Torsion Balance. E. Kappler. *Ann. d. Physik*, 31. 7. *pp.* 619–632, *April*, 1938.—A theory of errors is discussed, more specially applicable to the Brownian movement of a torsion balance, and applicable to the registration of such an oscillating system, whether continuous or discontinuous. J. S. G. T.

2274. Influence of a Magnetic Field on Molecular Brownian Motion. C. Schaefer. *Ann. d. Physik*, 32. 1–2. *pp.* 190–194, *May*, 1938. —It is shown theoretically that, contrary to an assertion of Svedberg, under certain conditions the influence of a magnetic field on Brownian motion should be detectable. Using particles the size of those used by Perrin in his classical investigation of rotational Brownian movement, a magnetic field should produce an appreciable heating effect. F. C. C.

See also Abstracts 2211, 2216, 2257, 2499, 2552.

LENGTH, AREA AND VOLUME.

***2275. Magnetic Comparator Metal Thickness Tester. A. B. Stevenson.** *Journ. Sci. Instruments*, 15. *pp.* 156–158, *May*, 1938.—A method of measuring the thickness of metal plates by comparison of the reluctance of the unknown and a standard reference piece is described, and curves of performance are given for one size of instrument. AUTHOR.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

***2276. Use of the Mader-Ott Harmonic Analyser. E. J. Nyström.** *Soc. Scien. Fennica, Comm. Phys.-Math.*, 9. 14. [10 *pp.*], 1938. *In German.* The Mader-Ott harmonic analyser is illustrated and very briefly described; its use for determining Fourier coefficients under normal and exceptional conditions is described. J. S. G. T.

2277. Approximations to Functions and to Solutions of Differential Equations. R. A. Frazer, W. P. Jones and S. W. Skan. *Phil. Mag.* 25. *pp.* 740–746, *May*, 1938.

2278. Use of Minimum χ^2 As Approximation to Method of Maximum Likelihood. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 34. *pp.* 156–157, *April*, 1938.

See also Abstracts 2235, 2273, 2311, 2425, 2539, 2541, 2610 and
1826B. Mechanical Construction of Special Curves. W. R. Crawford.
1828B. Matrix Solution of Polynomial Equations. L. A. Pipes.

MECHANICS, CLASSICAL.

2279. Extension of Jacobi's Theorem on Virial and Reference to Minimum Kinetic Energy. G. Lampariello. *Accad. Lincei, Atti.* 26. *pp.* 325–335, *Nov.* 21, 1937.—By Jacobi's equation potential is connected with the second derivative of the moment of inertia " J." Applying particular laws of force, the value of J as a function of time is easily obtained. The virial is introduced with respect to the barocentre and applied to the motion of a perfect fluid. Mutual attraction or repulsion inversely as the cube of the distance from the barocentre gives an equation which can be integrated to find the moment of inertia. Three coordinate axes are found with reference to which the kinetic energy of the system is a minimum. These axes may move relatively to another system having the barocentre as origin and particular solutions appear if the motion is planar, in which case one of the axes is perpendicular to the plane of motion. H. M. B.

2280. General Equations of Restricted Relativistic Dynamics. G. Garcia. *Accad. Lincei, Atti,* 27. *pp.* 23–26, *Jan.* 9, 1938.—A discussion is given of a material system of k degrees of freedom, or, in the analogous case of mobility, constituted of n bound points P_μ of mass $M_\mu(\mu=1, 2, 3, \ldots n)$. Reference is also made to the more general case in which certain bonds of mobility only are imposed on the system, those of position involving integral results. It is supposed that the effective displacements of the n points $P\mu$ of the system must re-enter into the scheme $dP_\mu = \sum_1^k \nu A_{\mu\nu} dq_\nu + A_\mu dt$, where the coefficients $A_{\mu\nu}$, A_μ $(\mu=1, 2, 3, \ldots n;\ \nu=1, 2, \ldots k)$ are vectors *a priori* of any value desired, functions of the configuration of the system, *i.e.*, of $P_1, P_2, \ldots P_n$, and of the time t. J. J. S.

2281. Mechanics of Muscular Contraction in Man. W. O. Fenn. *J. of Applied Physics,* 9. *pp.* 165–177, *March,* 1938.—The author discusses at length some of the mechanical aspects of muscular movement in man, which it is claimed can be demonstrated equally well or better than in animals. The discussions cover questions of muscular force and length, oscillatory movements, force in a moving limb, the relations between force, displacement and velocity, and the significance of viscosity in muscular mechanics. A number of experiments, some suitable for demonstration, are described. J. E. R.

***2282. Development of the Minor Axis in a Foucault Pendulum. B. Dasannacharya.** *Phil. Mag.* 25. *pp.* 601–622, *April,* 1938.—Earlier work on γ, the ratio of the minor to the major axis, showed that a more detailed study was required of the favoured directions, when they are small but not negligible. Details are given of experimental tests on (1) the variation of γ with initial values of the major axis, (2) change of Foucault rotation due to positive and negative values of γ, (3) variation of γ with the direction of the initial oscillation, (4) decrease of γ with more rigid fixing of the thread at the jaws, (5) the effects of different settings of the string, (6) the efficiency of the pendulum defined as a factor of merit, and its measurement, and (7) the origin of $\dot{\gamma}$ and the effect of drift rotation. R. S. R.

See also Abstract 2313 and
1871B. **Stress Recording Devices. H. Freise.**

MECHANICS, QUANTUM.

2283. Theory of Elementary Particles. G. Wataghin. *Accad. Lincei, Atti,* 26. *pp.* 282–285, *Nov.* 7, 1937.—A method for overcoming certain difficulties in the quantum theory is explored, in which second quantisation is applied to the fields of all the elementary particles. The equations of motion adopted contain no terms involving the constant of mass m which is regarded as arising from the interaction with the fields of other elementary particles. The method is applied to the interaction of electrons and photons and an expression is derived for the mass of the electron in a given energy state. For states of negative energy the electron mass comes out to be zero, a result which has a bearing on the theory of the positron as an unoccupied negative state. W. S. S.

2284. Relativistic Wave Equations. H. Yamamoto. *Japanese Journ. Phys.* 12. 2. *pp.* 27–38, 1938. *In English.*—A method of obtaining the solution of the system of wave equations for the Dirac electron is given by usual tensor calculus without making use of any spinor ideas. It is further shown that the operators which have characters similar to those of the orbital and spin angular momentum operators can be introduced in the tensor formulations. [See also Abstract 1531 (1937).] AUTHOR.

2285. Solutions of the Dirac and Photon Equations. G. Petiau. *Comptes Rendus,* 206. *pp.* 991–993, *March* 28, 1938.—Alternative formulations of the equations are derived and examined in relation to Schrödinger's treatment. N. M. B.

2286. Self-Consistent Field for Molecular Hydrogen. C. A. Coulson. *Cambridge Phil. Soc., Proc.* 34. *pp.* 204–212, *April,* 1938.—The method of the self-consistent field is applied to a discussion of the energy and wave-functions of the ground state of the hydrogen molecule; an analytical expansion of the wave-function is given in terms of spheroidal coordinates, and the distribution of charge is determined. Two simpler, though less accurate, wave-functions for the molecule are also included, and the possibility of using the method for more complex molecules is discussed. AUTHOR.

2287. Quadrupole-Quadrupole Interatomic Forces. J. K. Knipp. *Phys. Rev.* 53. *pp.* 734–745, *May* 1, 1938.—Atoms, the normal states of which are not S states, experience quadrupole-quadrupole repulsive and attractive forces which vary as the inverse fifth power of the separation distance. At large distances, exchange being negligible, the expression for the interaction energy contains as factors two atomic coefficients and a root of a secular equation determined by the molecular state of the system. For a given atom the coefficient is determined by the nature of its lowest level. If one uses the Hartree-Fock approximation, it is proportional to the average of the square of the radial atomic distance for those electrons with orbital angular momentum not in complete shells. Atomic coefficients have been calculated for most of the atoms of the periodic table having incomplete p and d shells and the secular equations have been solved for a number of cases. At distances of twice the sum of the atomic radii, diatomic molecules resulting from the combination of such atoms of the first row of the periodic table have quadrupole-quadrupole energies of a few tenths of a volt, such energies becoming rapidly larger for smaller distances because of the inverse fifth power dependence. AUTHOR.

See also Abstracts 2204, 2206, 2289, 2320, 2511, 2512, 2596.

PHILOSOPHY OF SCIENTIFIC METHOD.

2288. Science, Logic and Philosophy. H. Jeffreys. *Nature,* 141. *pp.* 672–676, *April* 16, *and pp.* 716–719, *April* 23, 1938.—The author discusses idealism *versus* realism, the uncertainty principle and probability. His standpoint is illustrated by the following extracts: "I do not believe that anybody is a realist. The great difficulty about idealism is that every idealist must have his own separate idealism. The use of language accepts the principle that generalisation from experience is possible. Generalisations from experience are not, however, made with certainty. Any theory of inference that can make only exact predictions or none at all is, for that reason, inadequate. The traditional idea of causality must be discarded as possibly wrong and certainly useless. Scientific success does not consist in exact correspondence but in the improvement of approximation. Probability must be introduced at some stage before we get practical results. Naïve realism as a scientific philosophy is simply wrong because it will not work in practice. Variation is to be taken as random until the contrary is shown. The rejection of unobservables in the quantum theory, so far as I can understand it, seems to be merely a spring-cleaning. I should disagree with the elevation of the rejection of unobservables into a magic philosophical principle. The Heisenberg uncertainty is but an estimate of a lower limit to the old uncertainty. Apparently the theory of probability makes no decision between critical realism and critical idealism." J. S. G. T.

RELATIVITY AND ETHER.

2289. Principles of Physics. W. Scherrer. *Helv. Phys. Acta,* 11. 3. *pp.* 219–224, 1938. *In German.*—The author suggests deficiencies in the theory of relativity, more especially its inability to treat the problem of two bodies. The unification of relativity and quantum theories is very briefly discussed, and the problem of many bodies is referred to. The Lagrangian function of two particles of masses M and m respectively takes the form $L = \Phi\dot{y}_k\dot{x}_k + (Mc^2\dot{y}_k\dot{y}_k + mc^2\dot{x}_k\dot{x}_k)/2$. J. S. G. T.

2290. System of Gravitational Equations of the First Order. G. Wataghin. *Accad. Lincei, Atti,* 26. *pp.* 285–289, *Nov.* 7, 1937.—Einstein's gravitational equations have been derived by the author from a system of equations of the first order. The geometrical interpretation of the latter is here developed using the notion of parallel displacement. W. S. S.

See also Abstracts 2280, 2321, 2323.

SOLUTION.

2291. Guggenheim's Theory of Strictly Regular Binary Liquid Mixtures. G. S. Rushbrooke. *Roy. Soc., Proc.* 166*A. pp.* 296–315, *May* 19, 1938.—An attempt is made to improve and extend Guggenheim's tentative theory of strictly regular binary liquid mixtures [see Abstract 1214 (1935)] by using Bethe's indirect method to avoid the unknown combinatory factor in the partition function for the liquid phase. The expression found in this way for the configurational energy of the mixture differs somewhat from that proposed by Guggenheim, and consequently formulæ for the thermodynamic functions are also modified. The conditions under which such solutions will exhibit critical mixing phenomena are discussed, and the variation with temperature of the concentration at which the liquid mixture begins to separate into two phases is investigated. Though for simplicity the theory is developed on the supposition that the molecules of the liquid are not close packed, numerical calculations for face-centred cubic packing, included in the last section, suggest that this does not significantly affect the results. AUTHOR.

2292. Solubility and its Variation. H. G. Trieschmann. *Zeits. f. phys. Chem.* 39. *Abt.B.* 3–4. *pp.* 218–245, 1938.—The solubility of acetanilide in organic solvents (alcohols, C_6H_5Cl, CH_3COCH_3, $(C_2H_5)_2O$, C_6H_{14}, CCl_4, C_6H_6, dioxan, H_2O), and in mixtures of solvents has been determined. The variation in solubility in the different solvents is discussed, with reference to the arrangement of molecules in solutions, and the properties of the solvents and solute. A. J. M.

2293. Solubility of Ag in Hg. R. J. Maurer. *J. Phys. Chem.* 42. *pp.* 515–519, *April,* 1938.—The solubility of Ag in Hg has been determined at six temperatures between 5° and 20° C., confirming the extension of DeRight's equation into this region [see Abstract 2825 (1933)]. A sintered glass filter proved highly satisfactory as a means of separating solid and liquid phases. AUTHOR.

2294. Solubility of Au in Hg. G. Mees. *Am. Chem. Soc., J.* 60. *pp.* 870–871, *April,* 1938.—About 70 determinations of the solubility of Au in Hg have been made, in the temperature interval 190 to 300°, with a modified solubility tube and an oil-bath. These determinations are in good agreement with an equal number of previous determinations made under different conditions. No maximum in the solubility curve, in this interval of temperature, has been found. AUTHOR.

See also Abstract 2305.

SURFACE PROPERTIES.

2295. Activated Adsorption of Methane on Reduced Nickel. M. Kubokawa. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 61–66, *Feb.,* 1938. *In English.*—The adsorption of CH_4 on reduced Ni has been investigated to elucidate the nature of the activated adsorption. This is considered to be followed by a successive dissociation of C–H bonds. The heat of activated adsorption of CH_4 on Ni is 12 kg.cal./mol. A. J. M.

2296. Air Adsorbed on Drops. W. Riedel. *Kolloid Zeits.* 83. *pp.* 31–32, *April,* 1938.—The thickness of the adsorbed air skin carried into 0·5% soap solution by a falling drop of sodium oleate solution was found by calculation from the measured volume. Four determined values ranged from 0·0004 to 0·0008 cm. P. H. B.

2297. Adsorption of H_2 by Cu Dispersed in MgO. J. R. Lewis and H. S. Taylor. *Am. Chem. Soc., J.* 60. *pp.* 877–879, *April,* 1938.—The adsorption of H_2 on pure Cu, on MgO and on Cu dispersed in MgO has been measured at 1 atm. and at various temperatures. It has been shown that both physical and activated adsorption occur in each case. Cu, when dispersed in MgO, is a better adsorbent for Hg and is also less likely to sinter than the pure Cu. The physical and activated adsorptions on MgO are separated by a wide temperature interval. AUTHORS.

2298. Statistical Theory of Adsorption with Long-Range Interaction. J. S. Wang. *Cambridge Phil. Soc., Proc.* 34. *pp.* 238–252, *April,* 1938.—The statistical theory of long-range interactions between adsorbed particles on a plane lattice is worked out approximately, by treating in detail the distribution of adsorbed particles among a few sites inside and on the boundary of a circular region, and regarding the distribution outside the circle as uniform and continuous with a density $K\theta$ per unit area, where K is the number of lattice points per unit area and θ is the fraction of surface covered by adsorbed particles. The continuous distribution begins at a distance ρ from the centre of the circle, ρ being determined by the condition that the probability of occupation of a first shell site is equal to the probability θ of occupation of the central site. Using this method, general formulæ for the adsorption isotherm and the heat of adsorption are obtained. Numerical applications for dipole interactions and for quadratic and hexagonal lattices are worked out in detail and the case in which the dipole moment varies with θ is discussed. AUTHOR.

2299. Adsorption on Curved Surfaces and Emulsification. H. M. Cassel. *J. Phys. Chem.* 42. *pp.* 475–482, *April*, 1938.—The thermodynamic theory of adsorption on curved surfaces leads to a relation analogous to the Gibbs–Thomson formula for the vapour pressure of droplets as a function of the curvature. In regard to the lack of direct experiments the theoretical expectations are checked by experience with emulsions. The basic idea is that emulsions can be stable only if the interfacial density of the emulsifying films is greater for surfaces of larger than for those of smaller curvature. There are no data available which would allow a quantitative comparison, but no facts seem to be known which are in contradiction with the theory. AUTHOR.

2300. Sorption of Water by Rubber. R. L. Taylor and A. R. Kemp. *Indust. and Engin. Chem.* 30. *pp.* 409–415, *April*, 1938.—The effect of several variables on the rate of sorption of water by rubber is discussed. Expressions based on short-time immersion tests are derived which permit calculation of the water content after an extended period of immersion under fixed conditions of temperature and vapour pressure. A sorption coefficient by which one material may be compared with another is suggested, and its application to practical problems is considered. AUTHORS.

2301. Measurement of Small Surface Tensions. J. Guastalla. *Comptes Rendus*, 206. *pp.* 993–995, *March* 28, 1938.—A waxed framework floats on the surface of water in a dish and a fine waxed silk thread, also floating, divides the liquid surface within the frame into two areas; the thread is connected with a torsion balance and when a monomolecular film is formed on one area in the frame the curvature of the thread varies and the surface tension is given by an expression deduced connecting the curvature, length, and tension of the thread. The arrangement, being aperiodic and almost free of inertia, is suitable for rapid measurements of small surface tensions. A method of producing films of known mass is described and results are plotted for three typical films. N. M. B.

2302. Surface Tension of Liquid He. J. F. Allen and A. D. Misener. *Cambridge Phil. Soc., Proc.* 34. *pp.* 299–300, *April*, 1938.—The surface tension of liquid He between 1·0 and 4·3° K. was measured by the capillary-rise method. Special attention was paid to the λ point (2·186° K.), the transition temperature between HeI and HeII, and some suggestion of a discontinuity of the temperature coefficient at this point was found. The values found for HeI agree well with those obtained by Onnes [see Abstract 1979 (1926)]. P. H. B.

2303. Interfacial Tensions of Mercury–Hydrocarbon Oil Systems. Part II. J. L. Culbertson and K. D. Luedtke. *J. Phys. Chem.* 42. *pp.* 469–473, *April*, 1938.—The method of Bartell and Miller [see Abstract 2895 (1928)] has been found suitable for interfacial tension measurements at a Hg–oil interface. Simple brominated hydrocarbons are found to lower the Hg–oil interfacial tension when the Br compounds are dissolved in the oil. [For Part I see Abstract 2439 (1937).] AUTHORS.

2304. Calculation of Surface Tension from the Measurement of Sessile Drops. A. W. Porter. *Phil. Mag.* 25. *pp.* 752–754, *May,* 1938.—Furnishes data which make the calculation of the surface tension from the measurements of drops possible for drops of all sizes. W. G. B.

2305. Properties of Detergent Solutions. J. Powney and C. C. Addison. *Faraday Soc., Trans.* 34. *pp.* 625–634, *May,* 1938.—Data are recorded for some binary systems of fatty acids in organic liquids. Saturated fatty acids having chain lengths of less than 13 carbon atoms form eutectic mixtures with benzene, whilst ricinoleic acid and linoleic acid give partial miscibility systems with benzene. The interfacial activity of saturated and unsaturated long-chain fatty acids and their solutions in xylene has been measured against water and aqueous soap solutions. It has been shown that when both the oil and aqueous phases contain an interface-active species, the nature of the resulting adsorbed film and the lowering of interfacial tension are dependent upon various factors, such as degree of unsaturation, pH gradient at the interface, and relative concentrations of the two species. [See Abstract 4371 (1937).] AUTHORS.

2306. Oxidation of Aluminium Foils. K. Tanaka and H. Kano. *Kyoto Coll. Sci., Mem.* 21. *pp.* 1–3, *Jan.,* 1938. *In English.*—Electron-diffraction examination of the γ–Al_2O_3 film, formed by the gradual heating of Al foil—either in air or in a vacuum camera—reveals that some grains of the cubic crystals of γ–Al_2O_3 arrange themselves in an orientation similar to that taken by the cubic crystals of Al in the original foil. It is found that this effect does not follow sudden and prolonged heating of the foil at 900° C. AUTHORS.

2307. Oxidation of Metals.—Part V. Oxidation of Molten Lead. L. L. Bircumshaw and G. D. Preston. *Phil. Mag.* 25. *pp.* 769–782, *May,* 1938.—Experiments on the formation of oxide films on molten lead at 500°, 600° and 700° C. show that the early part of the process is consistent with the "parabolic" law, the constant in the equation being proportional to the pressure. In several cases after the parabolic law has apparently ceased to be obeyed, the pressure falls in accordance with an equation of the type $\log p = kt + c$. An X-ray examination of the oxide film shows that it consists of two layers; red, tetragonal PbO next the metal and yellow, orthorhombic PbO at the oxygen-oxide surface. The latter oxide is very perfectly orientated with a (001) plane parallel to the metal surface: the photographs give the impression that this oxide is present as a thin single crystal film. [For Part IV see Abstract 4973 (1936).] AUTHORS.

2308. Polish on Metals. W. Cochrane. *Roy. Soc., Proc.* 166*A*. *pp.* 228–238, *May* 19, 1938.—When electron diffraction patterns consisting of diffuse rings are obtained by Thomson's reflection method, their interpretation is uncertain since such diffuseness may be caused by the geometrical configuration of the surface of the specimen. The pattern of two haloes obtained by previous workers from polished metal surfaces cannot, therefore, be held to prove the existence of an amorphous layer of metal although there is some evidence in favour of this view. In order to eliminate this difficulty, a thin layer of Au was formed on a Ni base. The Au film was polished, then stripped off and examined by transmitted electrons incident normal to the film. In this case the pattern does not depend on the form of the surface of the film. The resulting pattern consisted of three diffuse rings. It was deduced that the film consisted of very small crystal grains and that the atoms in the polish layer of a metal are arranged similarly to the atoms in a monatomic close-packed liquid at a given instant. After a period of 15 hr. the polished Au film yielded a pattern of sharp rings characteristic of polycrystalline Au, showing that crystal growth had taken place with a return to the normal crystal size. AUTHOR.

2309. Spreading of Substances on Water. Part I. L. A. Ramdas and P. S. Vaidyanathan. *Indian Acad. Sci., Proc.* 7*A*. *pp*. 186–195, *March*, 1938.—A slab of camphor floating on water dissolves much more quickly at the camphor-water-air boundary than elsewhere, on account of the monomolecular spreading over the water surface. The camphor thus distributed eventually turns down into the body of the water and forms convection currents. The rate of this boundary solution is proportional to the perimeter, and independent of the area and shape of the slab, the extent of the water surface, and the depth of the water. On allowing a monomolecular film of a soluble substance to spread on water the temperature of the surface layers rises to that of the body of the liquid on account of the convection associated with the spreading, and consequently evaporation increases. P. H. B.

2310. Arrangement of Molecules in Single and Multiple Layers. L. H. Germer and K. H. Storks. *J. Chem. Phys.* 6. *pp*. 280–293, *May*, 1938.—Layers of barium stearate 1,3,5, . . . molecules thick on polished Cr, and 2,4,6, . . . thick on Rezoglas [see Abstract 3331 (1935)] were examined by the (fast) electron diffraction method. In all cases the length of the molecules is perpendicular to the support, but in the unimolecular layer their direction varies up to 5° from the perpendicular, and the arrangement of the a and b axes (parallel to the support) is at random; in all thicker layers, whether on Cr or Rezoglas, the arrangement is regular with a 8·27, b 4·96 and β 70°. Stearic acid shows a similar but rather less regular arrangement. It is probable that interpretable patterns can be obtained with fast electrons for substances with considerably shorter hydrocarbon chains. C. A. S.

2311. Unit of Foaminess. J. J. Bikerman. *Faraday Soc., Trans.* 34. *pp*. 634–638, *May*, 1938.—The foaming capacity is established as a physical quantity, having the dimension of time, which to a large extent is independent of the apparatus and the technique employed. Its values for two specimens of *n*-butyl alcohol are recorded. AUTHOR.

2312. Energies of Adhesion and the Effectiveness of "Collectors" used in Froth Flotation. S. Valentiner. *Kolloid Zeits.* 83. *pp*. 1–9, *April*, 1938.—The parts played by collectors and froth-producing agents in froth flotation are discussed and the possibility of setting up an index to characterise the effectiveness of collectors is considered. Energies of adhesion for several systems of technical interest are calculated from the results of experimental determinations of the surface tensions of a number of solutions of various concentrations in water and benzene, their interfacial tensions relative to pure benzene and water respectively and the angles of contact with galena. L. A. W.

See also Abstracts 2224, 2237, 2248, 2252, 2466, 2519, 2555, 2564, 2565.

TIME.

***2313. Controlled 0·2-Second Pendulum. G. Turetschek.** *Zeits. f. Instrumentenk.* 58. *pp*. 157–163, *April*, 1938.—Details are given of the control of a 0·2-sec. pendulum by means of a seconds pendulum operating through photo-cell, thyratron, differential relay, and final electromagnetic system. The theory of a pendulum subjected to regular impulses of frequency almost equal to that of the pendulum itself is given. P. H. B.

See also Abstract 2321 and
1868B. Timing Devices. P. M. Pflier.

VISCOSITY AND FRICTION.

2314. Reaction Rate Theory of Viscosity and Some Applications. R. H. Ewell. *J. of Applied Physics,* 9. *pp.* 252–269, *April,* 1938.—Recently Eyring [see Abstract 2303 (1936)] has published an ingenious treatment of viscosity, plasticity and diffusion wherein flow was considered as a unimolecular chemical reaction in which the elementary process is the passing of a molecule (or other unit of flow) from one equilibrium position to another over a potential energy barrier. Since this treatment is based on the modern theory of chemical reaction rates, the latter theory is briefly discussed at the outset and then applied to the flow of matter which results in permanent deformation and thence to several types of viscous and plastic materials. The general features of the theory apply to flow in all condensed phases, or more specifically to phases where viscous drag due to transfer of molecules between layers is negligibly small (*e.g.*, gas type of viscous drag) and include liquids of all sorts, glasses and resins, and crystals. It is emphasised that potential energy barriers seem destined to play an ever-increasing rôle in modern physics. H. H. Ho.

2315. End Correction of Cylindrical Tube Traversed by Current of Gas. A. Foch, A. Fortier and J. Fivet. *Comptes Rendus,* 206. *pp.* 1082–1083, *April* 4, 1938.—The correction m has been variously determined as 1, 1·16 and 1·21 by various investigators. Experiments with a tube of $l = 40$ cm. $R = 0·5$ mm., traversed by dry air at velocities of $1 - 12$ cm.^{3}/sec., uniformly gave $m = 1·34$. [See also Abstract 491 (1936).] C. A. S.

2316. Theory of Oscillating Disc Method of Measuring Viscosity and Slip of Fluids. G. E. Macwood. *K. Onnes Lab., Leiden, Comm. Suppl. No. 84b. Physica,* 5. *pp.* 374–384, *May,* 1938. *In English.*—The theory of the oscillating disc is developed for a fluid of any density, viscosity and exhibiting slip phenomenon. Two special cases are considered, which together will include all possibilities. The end correction and laminar fluid motion are considered. AUTHOR.

See also Abstracts 2251, 2519.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***2317. Spectrophotometric Applications of Wood Replica Gratings. F. L. Whipple and D. Norman.** *Harvard Coll. Obs., Bull. No.* 908. *pp.* 21–24, *March* 1, 1938.—Wood replica gratings have been used as the dispersive element in a slitless spectrograph and as the basic component of a colour-index method whereby red and blue stellar images are obtained simultaneously on a single photographic plate. AUTHORS.

COMETS AND METEORS.

2318. Building of Larger Bodies from Small Particles in Interstellar Space. A. Corlin. *Zeits. f. Astrophysik*, 15. 4. *pp.* 239–262, 1938. *In English.*—Current theories regarding the origin of meteorites are shown to be unsatisfactory. It is suggested that their formation may be explained by cosmic ray " bursts " occurring in interstellar bodies and sending out electrons, thus leaving the body positively charged, in which state the thus charged body may increase its mass by attracting other neutral or negatively charged particles ; then, when it has itself become neutral it may be attracted by other bodies charged up by cosmic rays. Calculations based on plausible assumptions give as the limiting size a body could attain in this way just the size of the largest chondrules found in meteorites, and the time in which this could be is of the order of the age of such meteorites as deduced from their radioactivity. C. A. S.

COSMOGONY.

2319. Homogeneous Metrics in Cosmogonic Space. D. D. Kosambi. *Comptes Rendus*, 206. *pp.* 1086–1088, *April* 4, 1938.—The Milne differential equations obeyed by the trajectories of the fundamental particles in an expanding universe are put into tensorial form, using a new parameter τ related to the time. The author seeks a homogeneous " metric," *i.e.*, a function f of the fundamental quantities such that $\delta\int f\,d\tau = 0$. The form of this function is defined by 3 theorems corresponding to various special cases. A. Hu.

2320. Wave-Mechanics and Stellar Theory. H. Jehle. *Zeits. f. Astrophysik*, 15. 3. *pp.* 182–224, 1938.—The stellar system is first described in terms of a generalised " cosmological wave-mechanics." The introduction of a wave-mechanical picture for the study of interaction between a collection of masses is justified on statistical grounds. The classical laws of motion for a stream of particles are fulfilled by the wave-mechanical model even outside the limiting case of small wave-lengths. A new formulation of stellar statistics is introduced, based in particular on an assumption, which is shown to be reasonable, with regard to the peculiar velocities of the stars. The particular case of Saturn's rings is gone into in detail. It is further shown that the mutual perturbations of the planets stipulate a relation between their mean distances from the sun which is fulfilled in moon systems as well as in planetary systems. Finally the wave-mechanical model of galactic systems yields a relation between the age, mass, and absolute diameters of the spiral nebulæ. A. Hu.

2321. Meaning of Uniform Time and the Kinematic Equivalence of the Extra-Galactic Nebulæ. E. A. Milne and G. J. Whitrow. *Zeits. f. Astrophysik*, 15. 4. *pp.* 263–298, 1938. *In English.*—Starting from the existence of a temporal sequence for events at any given observer, various problems of time-keeping are stated and solved. Given an arbitrarily graduated clock, it is shown how to define a congruent clock at a distance for any relative motion. A set of observers possessing clocks all congruent to one another constitutes an " equivalence." An equivalence of any type may be converted into one of any other given type by appropriate re-graduation of clocks. Amongst all possible regraduations of the clocks of an equivalence, two stand out with special properties, namely the one (regraduation to t) which reduces the equivalence to a " uniform relative motion " equivalence, and the one (regraduation to τ) which reduces the equivalence to a " relatively stationary " equivalence. A "substratum" is an equivalence in which attention is paid to the distribution of the particles. By deriving the laws of dynamics holding good in the presence of a uniform motion substratum, and then regraduating to give a relatively stationary substratum, it is shown that the "uniform time" of mechanics is to be identified with τ-time, the uniform time of optics with t-time. The reason for this is that the universe is to be identified with a substratum. Hubble's two alternative accounts of the universe, with and without recession, are shown to correspond to the two different descriptions of the same phenomenon according as the t- or τ-scale is used. "Proper time" has no absolute meaning, but only a meaning in connection with the adoption of dynamical laws in a selected form. [See also Abstract 1977 (1937).] AUTHORS.

See also Abstracts 2323, 2325, 2347.

LATITUDE AND LONGITUDE.

2322. New Observing Programme for the International Latitude Service. H. Kimura. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 102–105 *March,* 1938. *In English.*

NEBULÆ.

2323. Expansion of a Nebula. N. R. Sen. *Calcutta Math. Soc., Bull.* 29. *pp.* 185–196, *Sept.–Dec.,* 1937.—The orbits of particles moving in the Schwarzschild field of force to which has been added a "cosmical repulsion" proportional to the distance of the particle from the attracting centre are worked out. Certain orbits will not be bounded and a consideration of these orbits suggests that a spiral nebula may be expanding as a result of the expansion of the universe. Numerical estimates show that the velocity of escape may be much smaller than the classical velocity of escape when the nebula is of the order of our own galaxy. G. C. McV.

2324. Ages of Planetary Nebulæ. F. L. Whipple. *Harvard Coll. Obs., Bull. No.* 908. *pp.* 17–20, *March* 1, 1938.—By applying the expansion hypothesis to the planetary nebulæ, "quasi-ages" for 24 of the best-observed planetaries are determined from the linear dimensions and rates of expansion. Values of the order of 15000 yr. are obtained. The possible errors produced by effects of projection and by crude velocity measurements, uncorrected for finite slit-width, photographic turbidity, and intrinsic line-width, are discussed. Observational selection arising from the difficulty of observing small velocities tends to reduce the average age and to distort the frequency distribution curve. The assumption of an equilibrium state in the formation and dissipation of planetary nebulæ, justified in view of the relatively short time-intervals involved, suggests that one nebula should be formed and another fade out at 200-yr. intervals approximately. If exceedingly slow-acting and low-velocity novæ result in planetary nebulæ, then only one out of a few thousand novæ should be of the correct type. The atmospheres of most Novæ expand too rapidly to remain visible for long intervals of time, even though the central stars should remain bright. A. Hu.

2325. Distances of Extra-Galactic Nebulæ. G. C. McVittie. *Roy. Astron. Soc., M.N.* 98. *pp.* 384–397, *March,* 1938.—The empirical formulæ giving the numbers of extra-galactic nebulæ and the red-shift in terms of apparent photographic magnitude are analysed and shown to imply at least five different definitions of distance. Hubble's small spherical universe depends on the choice of one of these definitions dictated by the hypothesis that the equation $K = 1 \cdot 83\delta$, relating the red-shift δ to the conversion-factor K for passing from bolometric to photographic magnitude, is strictly accurate. Moreover, Hubble's method leads to a value for the total density of matter in space, which turns out to be one thousand times greater than that calculated from the luminous nebulæ alone. On the other hand, if no *a priori* definitions of distance are used so that the value of K need not be known, but if the average mass of a luminous nebula is regarded as known, the nebular counts lead to a hyperbolic universe. In this universe it can be shown that the value of K must be $(1 \cdot 08 \pm 0 \cdot 10)\delta$. AUTHOR.

2326. Multiple Extra-Galactic Nebulæ. W. Fricke. *Naturwiss.* 26. *pp.* 257–262, *April* 29, 1938.—An analogy is drawn between the double stars, multiple star systems, open clusters and star clouds in our stellar system and the corresponding configurations of spiral nebulæ outside it. Only in the case of stellar globular clusters has no analogue been found amongst the nebulæ. It is pointed out that the approximate equidistance from us of the members of multiple nebular systems is of importance in elucidating the differences in their structure and absolute magnitudes, and in studying the recession problem. The present state of our knowledge of these multiple systems is summarised under the following heads: the local group of extra-galactic nebulæ; classification by structure; nebular clusters; binary nebulæ; absolute brightness and dimensions; existence of a metagalaxy; origin of double and multiple nebulæ. A. Hu.

See also Abstract 2339.

PLANETS.

2327. South Equatorial Current of Jupiter. A. S. Williams. *Roy. Astron. Soc., M.N.* 98. *pp.* 411–413, *March*, 1938.—Recent additional observations now show with certainty that the general decrease in the velocity of the south equatorial current previously indicated [see Abstract 2591 (1936)] did actually continue to the year 1931, *i.e.* for over 50 years. Between 1880 and 1931 this decrease amounted to 40 km./hr. The mean velocity curve fails to indicate any connection with the solar influences, such as the 11-year sunspot period or the period of the planet's revolution round the sun, nor indeed with any long-period periodicity. The change would therefore seem to have originated in the planet itself. AUTHOR.

See also Abstracts 2336, 2337.

STARS.

2328. Redetermination of Photographic Magnitudes in the Harvard Standard Regions at +15°. J. L. Greenstein. *Harvard Coll. Obs., Ann.* 89. 11. *pp.* 179–190, 1937.

2329. Errors in Photoelectric Stellar Photometry. E. J. Meyer. *Zeits. f. Astrophysik,* 15. 3. *pp.* 163–172, 1938.—Random fluctuations in determinations of stellar intensities obtained with certain photo-cells are considered, as a result of suitable laboratory experiments, to be due to non-uniformity of the sensitivity of the photo-sensitive surface of the cells; the fluctuations arise on account of the inconstancy of the distribution of intensity over the surface. [See also Abstract 645 (1936).] D. H. F.

V.
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2330. Accuracy of Parallaxes Determined from Spectral Class and Proper Motion. W. J. Luyten. *Roy. Astron. Soc., M.N.* 98. *pp.* 408–410, *March*, 1938.—Parallaxes computed by the writer [see Abstract 1737 (1924)] from spectral classes and proper motions are compared with subsequent trigonometric determinations, and it is found that even for an individual star a parallax calculated in this way is as reliable as a single trigonometric determination when the parallax is of the order of 0″·035.

AUTHOR.

2331. Stellar Parallaxes with the 60-in. and 100-in. Reflectors (Sixteenth Series). A. van Maanen. *Mt. Wilson Observat. Contrib. No.* 590. *Astrophys. J.* 87. *pp.* 424–427, *May*, 1938.—Results are given for 25 fields including 28 stars, 15 of which have photographic absolute magnitudes of + 10 or fainter; 3 are even + 15 or fainter. One white dwarf is included, AC + 70°8247, for which the absolute magnitude is + 11·9. For U Geminorum and SS Cygni the absolute parallaxes are + 0″·010 and − 0″012, respectively.

AUTHOR.

2332. Parabolic Double-Star Orbit. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 98. *pp.* 380–383, *March*, 1938.—A graphical method of computing a parabolic double-star orbit is described and applied to Σ 1639. It is suggested that observations of this star and of σ_2UMa, to which a parabolic orbit has also been fitted, should be intensified in the hope of determining the eccentricities definitively.

AUTHOR.

2333. Absorption Line at λ4430·6 of Possible Interstellar Origin. C. S. Beals and G. H. Blanchet. *Roy. Astron. Soc., M.N.* 98. *pp.* 398–407, *March*, 1938.—A broad ill-defined line about 40 Å in width and of approximate wave-length λ4430·5 has been observed in the spectra of a number of early type stars. The equivalent width of the line is shown to exhibit a marked correlation with that of interstellar K, suggesting that λ4430 may also be of interstellar origin. The diffuse character of the line has so far rendered unsuccessful any attempts to establish its stationary or non-stationary character in spectroscopic binaries. Possibilities for the origin of the line would appear to be limited to absorption by gaseous molecules or by particles of solid material in interstellar space.

AUTHOR.

2334. Curves of Darkening in Photographic Astrophotometry. H. Grouiller. *Comptes Rendus*, 206. *pp.* 1089–1090, *April* 4, 1938.—For the gauge on photographic plates, the ray used should be of the same spectral composition as that from the astronomical source. The author uses an artificial source, a tungsten lamp, and filters its light by a law depending on the star's type. In practice he photographs the sun's spectrum projected on plaster of Paris, reducing it by the black body equivalent to the required spectral type. He discusses the systematic errors entailed by this method; these include variation of the contrast factor, which, for the type of plate (Superfulgur) considered, is greater for long than for short waves. A quantitative estimation is obtained for the errors of photographic Purkinje effect.

A. S. D. M.

2335. Atomic Lines in the Spectrum of Antares. D. N. Davis. *Astrophys. J.* 87. *pp.* 335–351, *April*, 1938.—A complete study of the spectrum of Antares involves identification of both atomic and molecular lines. A detailed study is made here of all atomic lines found on high-dispersion plates. Comparison is made throughout with the behaviour of lines in the spectra of the sun and Arcturus. A table of 3625 wave-lengths, estimated intensities and identifications for the region λλ3600–6600 has been compiled, and there is quite definite evidence for the presence of 29 elements. The identification of 16 more is questionable, for 10 the stellar data being insufficient whilst in the remaining cases the laboratory evidence is insufficient. Of the remaining 31 elements which are apparently absent, 5 are not expected to be detectable because of high atomic weight and low abundance whilst 20 have inaccessible ultimate lines. In the latter group are 5 elements—B, C, N, O and F—whose presence is established by molecular evidence. Finally, there is abundant evidence to indicate that the temperature of Antares is lower than that of Arcturus. A. H.

2336. Possibility of Detecting H_2 and N_2 in Planetary and Stellar Atmospheres by their Rotation-Vibration Spectra. G. Herzberg. *Astrophys. J.* 87. *pp.* 428–437, *May,* 1938.—The detection of H_2 and N_2 in planetary or stellar spectra, hitherto deemed impossible, can be carried out by means of the rotation-vibration spectrum of these molecules. Though H_2 and N_2, as is well known, have no ordinary rotation-vibration spectra (since their dipole moment is zero), they do have rotation-vibration spectra, owing to their *quadrupole moment.* In the case of H_2 the 1–0 band of this quadrupole rotation-vibration spectrum, according to calculations of James and Coolidge [see following Abstract] is $8\cdot1 \times 10^{-9}$ times as intense as the 1–0 band of the ordinary rotation-vibration spectrum of HCl. The minimum absorbing layer necessary to detect the 1–0, 2–0, and 3–0 bands is found to be 2·5, 2·7 and 13·0 km. atm., respectively. This is of the order of magnitude probably available in the atmospheres of the major planets. A table of the positions of the lines of the 1–0, 2–0, 3–0 and 4–0 bands as predicted from the u.v. H_2 spectrum is given. The band most favourable for detection is the 3–0 band at 8500 Å. Failure to observe this band would at least give an upper limit for the amount of H_2 present in the atmospheres of the major planets or of low-temperature stars. For N_2 the predicted positions of the Q branches of the bands are given. Their detection will probably be more difficult than the detection of the H_2 bands. A further possibility of detecting molecular hydrogen and nitrogen is by the ordinary rotation-vibration spectrum of the isotopic molecules HD and $N^{14}N^{15}$, which are always present in natural H_2 and N_2, respectively. AUTHOR.

2337. Quadrupole Rotation-Vibration Spectrum of H_2. H. M. James and A. S. Coolidge. *Astrophys. J.* 87. *pp.* 438–459, *May,* 1938. —The theory of the quadrupole radiation of homonuclear diatomic molecules is developed for the case of transitions between $^1\Sigma$ states. The results are applied in a theoretical treatment of the rotation-vibration spectrum of H_2, which, as Herzberg has suggested [see preceding Abstract] may be observable in the absorption spectra of planetary atmospheres. The quadrupole moment of the system is computed as a function of the nuclear separation by the use of electronic wave functions obtained by a variational process. Matrix elements of this quantity are calculated, using the vibrational functions of the Morse and Poschl-Teller potential-curves. Absolute values are found for the Einstein absorption coefficient B for fundamental, first, and second overtone bands, and are compared with the corresponding quantities for the dipole spectrum of HCl. It is found that the first and second overtone bands have intensities in the ratios 0·91 and 0·19, respectively, to that of the fundamental, and that, while this is an exceptional case, one should, in general, expect the ratios to be higher in quadrupole than in dipole bands. AUTHORS.

2338. Colour Indices of Stars from a Classification of their Spectra. W. W. Morgan. *Astrophys. J.* 87. *pp.* 460–475, *May*, 1938.—A discussion of Bottlinger's photoelectric colour indices of the near-by stars of types F5–M0 is made in combination with a classification of spectral type and luminosity. It is found that, within the errors of observation, the intrinsic colours of the stars are uniquely defined by their spectral types and absolute magnitudes. The colour indices of stars unaffected by selective interstellar absorption can be predicted with accuracy from a classification depending on line ratios within their spectra. The suitability of the F5–G0 main sequence stars as colour standards is pointed out. For these stars colour indices can be predicted which have a mean error of the order of ± 0·02 mag. on Bottlinger's scale. AUTHOR.

2339. Ionisation and Recombination in the Theory of Stellar Absorption Lines and Nebular Luminosity. S. Chandrasekhar. *Astrophys. J.* 87. *pp.* 476–495, *May*, 1938.—In this paper the effect of collisions and photo-ionisations on monochromatic radiative equilibrium is considered. A formalism is developed which includes the theory of stellar absorption lines (Strömgren) and the theory of nebular luminosity (Zanstra) as two limiting cases. A second approximation for the nebular problem is also sketched. The mathematical analysis is devoted to the treatment of the three-state problem including collisions. When collisions can be neglected, the approximate equations of transfer used admit of two flux integrals and two K-integrals. AUTHOR.

2340. Form of Rotating-Gas Configurations. Z. Kopal. *Roy. Astron. Soc., M.N.* 98. *pp.* 414–424, *March*, 1938—A study of rotating gaseous configurations is based on the consideration of the function e/v where e is the oblateness of the gas spheroid and v is proportional to the ratio of the square of the angular velocity of rotation to the density. One polytropic and two non-polytropic models are discussed. It is concluded that the orders of magnitude of the density condensations in eclipsing binaries, arrived at by a consideration of their ellipticities, are true whether these stars are complete polytropes or not. G. C. McV.

2341. Square of Angular Velocity of Fluid Star Expressed as Analytic Function. P. Dive. *Comptes Rendus*, 206. *pp.* 987–988, *March* 28, 1938.—The conditions under which certain integrals involved in the square of the angular velocity of rotation give rise to holomorphic functions are studied. G. C. McV.

2342. Stellar System of New Type. H. Shapley. *Harvard Coll. Obs., Bull. No.* 908. *pp.* 1–11, *March* 1, 1938.—About 2° south of α Sculptoris, near the south galactic polar cap, free from space-absorption uncertainties, and with few foreground stars, there is a cluster of stellar images (of magnitudes down to 19·5 or 19·7) of about 2° dia., without nucleus or conspicuous central star. Most of its members are of extreme faintness, but its brightest individuals are of the 18th mag., forming a central east-to-west elongation. The total number of stars counted is 16592, and intermingled with these are external galaxies (2059 were found in this region on the discovery plate), but none of these can be associated with the stellar cluster. The author considers it a globular cluster free of highly luminous stars. For distance four assumptions are made: absolute magnitude of brightest stars, (1) − 1·5; (2) − 6·5; (3) + 5·5 (a cluster of dwarf stars within our galaxy); (4) − 16·5 (highly condensed spheroidal galaxies). The first assumption is the most probable. A. S. D. M.

2343. Radiometric Magnitude of Epsilon Aurigæ. R. M. Emberson, R. Loevinger and T. E. Sterne. *Harvard Coll. Obs., Bull. No.* 908. *pp.* 11–14, *March* 1, 1938.—Radiometric measures on seven nights were made to test Kuiper, Struve and Strömgren's theory that during the total eclipse phase, visual light originates in the eclipsed cF_2 star, its companion being a large semi-transparent star of low temperature [see Abstract 535 (1938)]. The comparison star was Capella, and some evidence was found of progressive radiometric brightening. The heat index is $0^{m}\cdot51$, somewhat larger than that of a normal F_2 star. The authors compare their own predictions of effective temperatures of the cF_2 and of the large star; of the inclination, longitude of periastron, ratio of radii, with those given by the classical theory, and by Kuiper, Struve and Strömgren; they find good agreement for the total radiometric magnitude of the cF_2 star with the latter, and not with the classical theory. A. S. D. M.

2344. System of α Ursæ Majoris. H. Spencer Jones and H. H. Furner. *Roy. Astron. Soc., M.N.* 98. *p.* 430, *March*, 1938.—A correction. [See Abstract 1060 (1938).]

2345. Spectral Variations of P Cygni. P. Lacroute. *Comptes Rendus*, 206. *pp.* 1091–1092, *April* 4, 1938.—From 1937, Sept. 23–Dec. 11, the author has followed in a slit spectrograph the short period u.v. variations (between Hγ and the last of the Balmer series) of this ancient (1600) Nova. The absorption component nearest the emission (R) is often the most intense, confirming Wilson [see Abstract 504 (1936)]. Component V was barely visible on Sept. 29, was not seen in Oct., but reappeared Nov. 13; declining after Nov. 22, but remaining more intense than R until equality on Nov. 30; R was the more intense on Dec. 10 and 11. V was thus strong for a fortnight; but it is not yet determined whether these variations are periodic. On the whole, these variations do not join up those, found by Gerasmovič, with Wilson's, nor has the author found with certainty the feeble emission line on the violet side of the absorption band of Hγ. A. S. D. M.

2346. Orbit of the Visual Binary $O\Sigma77$ and the Mass-Luminosity Relation. G. Durand. *Comptes Rendus*, 206. *pp.* 1093–1094, *April* 4, 1938.—Observation shows that the orbit of this binary is either an ellipse of small eccentricity and long period or one of great eccentricity and short period. The mass-luminiosty relation applied to this problem shows that the latter type of orbit is not permissible. G. C. McV.

2347. Method of Determining Interstellar Coloration of Faint Stars. W. Becker. *Zeits. f. Astrophysik*, 15. 3. *pp.* 225–237, 1938.—A method is described whereby from brightness observations in the regions above, below and around 480 $m\mu$ and the two colour index systems derived therefrom it is possible to determine the interstellar coloration of very faint stars without it being necessary to know their spectral types. The method depends on the existence of two spectrophotometric intensity gradients, intersecting at about 480 $m\mu$, as a result of the deviation of stellar from black-body radiation. The application of the method is illustrated with reference to some examples from existing colour-index systems. Theoretically the method should permit the separation of dwarfs, giants and super-giants and the determination of the wave-length law of the coloration and make possible a study of the spatial distribution of discolouring (absorbing) matter. J. E. K.

See also Abstracts 2317, 2320, 2433.

SUN.

2348. Coronal Polarisation. W. M. Cohn. *Astrophys. J.* 87. *pp.* 284–334, *April*, 1938.—Polarigraphs of 35 1/4- and 60-in. focal lengths, equipped with Wollaston prisms and Wratten filters, are used, intensity marks being printed on each plate. The polarisation is determined as a function of the distance from the sun's limb and of the wave-length, whilst the influence of prominences on the polarisation of the corona is also investigated. Throughout the influence of skylight on the corona polarisation is eliminated. The plane of polarisation of the corona is generally radial, such deviations as occur being due to the greater amount of polarisation at the equator than at the poles, and to the difference in brightness of different parts of the corona. The distribution of particle sizes in the corona is also discussed, and the average size is found to increase on moving outwards. The average particle diameter close to the limb is less than 100 $m\mu$, beyond $4'\cdot 5$ it is less than 170 $m\mu$. The appearance of sharp Fraunhofer lines 5′ from the limb is explained by the reflection and diffraction of sunlight by particles which are large compared with short wave-lengths but small compared with long. A. H.

2349. Mean Areas and Heliographic Latitudes of Sunspots in the Year 1936. *Roy. Astron. Soc., M.N.* 98. *pp.* 425–427, *March*, 1938.

2350. Absence of Continuous Absorption in the Solar Spectrum. M. Minnaert and J. K. van den Briel. *Zeits. f. Astrophysik*, 15. 3. *pp.* 173–181, 1938.—It is calculated on Pannekoek's theory that continuous absorption at the head of the 3P-mD series in Na should show itself in the solar spectrum by a discontinuity in the continuum at $\lambda 4080$. The intensity of the continuous spectrum should fall as the head of the series is crossed in the ratio 6·12 : 3·32 at the centre of the sun ; at the limb the ratio should be 1·3 : 1·0. Spectrograms taken at Utrecht show no such discontinuity either at the centre or at the limb ; microphotometer traces reproduced show that the corrected background of the Fraunhofer lines is practically level in the region $\lambda\lambda 4012$-4159. Possible explanations of the absence of the expected discontinuity are put forward : these include the effects of the Urey factor, of the static Stark effect, of pre-ionisation, of the dynamic Stark effect, and of fluorescence. A. Hu.

See also Abstract 2369.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

See Abstract 2639 and

1838B. Properties of Geological Conductors. V. Fritsch.

HYDROSPHERE, PHYSICS OF THE.

2351. Non-Homogeneity of Gradient Currents. T. Gustafson. *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 65–87, 1938.—A two-dimensional depression on the bottom of the sea is considered and for it the gradient current is calculated for a rotating earth taking account of dynamical pressure and the vertical current of the Coriolean force. This is possible for profiles for which the Green function is known. If the time in pendulum hours of passage through two similar profiles is the same, the currents are similar. Change in the vertical dimensions of the depressions produces proportionate change in the horizontal deviations of the current. The current can also be calculated, for small inclinations, for complicated profiles. The first approximation of the current presents a deviation varying with depth. For a N-S current the non-homogeneity is still important for broad depressions at the bottom, but for E-W currents apparently compensating effects reduce the non-homogeneity. For gradient winds the secondary currents can be neglected for depressions of moderate depth but for ocean currents they are often of dominant importance. Even when the depth of the depression is very great compared with the depth of the sea there is an inhomogeneity in the current due to the combined influence of the vertical and horizontal components of the Coriolean force. The mean displacement for broad depressions equals that for homogeneous gradient currents. The non-homogeneity is a characteristic feature of gradient currents of variable depth. R. S. R.

2352. Work of Drifting North Polar Station. P. Shirshov and E. Fedorov. *Nature*, 141. *pp.* 629–632, *April* 9, 1938.—A survey is given of the work carried out during 1937-38 in the region of the North Pole. Observations on the movement of the ice show this increases with distance from the pole. The causes of the direction and speed of the movement are discussed. A large number of observations on the direction of movement of the water show motion in different directions at different depths. The depth of the sea bed and the composition of the surface of the bed were also investigated. Soundings reveal that under a thin layer of cold water, water with positive temperatures exists. Samples of plankton also were found at different depths, and animal and bird life observed. Measurements of the force of gravity indicate regions of positive and negative anomaly. On the other hand, magnetic measurements indicate no marked magnetic anomalies over the course of the drift. From meteorological observations it is concluded that the weather in the region of the pole is considerably calmer than on the borders of the Arctic ocean. A. E. M. G.

LAND, PHYSICS OF THE.

2353. Disturbance of Temperature Gradient in the Earth's Crust by Inequalities of Height. E. C. Bullard. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 4. *pp.* 360–362, *May*, 1938.—The temperature gradients at six bores and at one point in the Simplon tunnel are corrected for the influence of topographical irregularities. The correction is negligible for the bores and is 15% for the tunnel. Thus the correction need only be applied in very mountainous country. AUTHOR.

2354. Velocity of Elastic Waves in Sand. K. Iida. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 131–144, *March*, 1938. *In English.* —The velocities (V_t, V_l) were determined of transverse and longitudinal elastic waves in sands of four different degrees of fineness and close-packing and containing varying (0-24%) amounts of moisture. V_t decreases rather rapidly with increased moisture content; V_l increases when this exceeds 19%. Both V_t and V_l are greater through fine- than through coarse-grained sand. The elastic constants were also determined. C. A. S.

2355. E.H.F. Electrical Constants of Soil. M. K. Chakravarty and S. R. Khastgir. *Phil. Mag.* 25. *pp.* 793–801, *May*, 1938.—The attenuation of ultra-short waves travelling along a Lecher-wire system immersed in a specimen of Dacca soil was determined for a certain range of ultra-high frequencies (73 to 89 Mc./sec.) and for varying moisture-contents from 8 to 41%. The values of the electrical conductivity σ and the dielectric constant ϵ of the soil were then determined by the application of the standard formulæ. The value of the dielectric constant of the specimen of the soil varied from 3·95 e.s.u. at a moisture-content of 8% to 29·4 e.s.u. at a moisture-content of 41%. The value of the electrical conductivity was of the order of 10^{-14} e.m.u. It increased with moisture-content. The electrical conductivity of the soil was found first to increase and then to diminish with the increase of frequency. The dielectric constant of the soil was found to diminish with the rise of frequency, as is expected from Debye's theory of h.f. dispersion in polar liquids. It is to be noted that the values of the electrical conductivity and the dielectric constant of the soil obtained by the direct laboratory method agree well with the values estimated from the attenuation measurements. AUTHORS.

METEOROLOGY.

2356. Artificial Production of Carbon Dioxide and its Influence on Temperature. G. S. Callendar. *Roy. Meteorolog. Soc., J.* 64. *pp.* 223–237 ; *Disc.*, 237–240, *April*, 1938.—By fuel combustion man has added about 150,000 million tons of CO_2 to the air during the past half century. The author estimates from the best available data that approximately three quarters of this has remained in the atmosphere. The radiation absorption coefficients of CO_2 and H_2O are used to show the effect of CO_2 on " sky radiation." From this the increase in mean temperature, due to the artificial production of CO_2, is estimated to be at the rate of 0·003° C. per year at the present time. The temperature observations at 200 meteorological stations are used to show that world temperatures have actually increased at an average rate of 0·005° C. per year during the past half century. AUTHOR.

***2357. Characteristics of Pyrheliometer with Spherical Absorber. L. F. Miller.** *Rev. Sci. Instruments*, 9. *pp.* 127–131, *April*, 1938. —The outstanding features of the pyrheliometer with spherical absorber are (1) the quartz bulbs arranged in Y forms, (2) a very thin blackened silver sphere, (3) a near X-ray vacuum and (4) a calibrated thermocouple. The advantages claimed are (1) the wide scope of wave-lengths of radiations transmitted and absorbed, (2) the almost complete sweep of all sky radiation, (3) the same degree of sensitivity for all positions of the sun, and (4) its elimination of conduction and convection of gases so that its operation is almost entirely based on a simple radiation principle. It thus possesses a geometrical, thermal and optical symmetry unobtainable by the horizontal flat disc absorber. Measurements show that less than 1% of the received energy is transmitted along the thermocouple wires, the remaining 99% leaving the blackened sphere by re-radiation. The equilibrium condition between the sphere and its surroundings can therefore be represented with a high accuracy by the Stefan-Boltzmann law. Measurements made with two specially constructed flat disc absorbers showed that they did not obey the cosine law, the real absorption being less than the cosine values by amounts varying from 58% at 85° inclination to 1·6% at 20° inclination. Comparative results are given for three instruments of the spherical absorber type. A. W.

2358. Diurnal Variation of Wind-Vector Due to Variation of Eddy Viscosity. T. Namekawa and T. Takahasi. *Kyoto Coll. Sci., Mem.* 21. *pp.* 31–38, *Jan.*, 1938. *In English.*—Following references to previous work the authors endeavour to construct a dynamical theory concerning the origin of the diurnal wind vector. A simplified case is treated, and an approximate solution of the dynamical equations obtained, and thus an expression for the resultant wind vector. Two numerical examples are given and on two sets of vector diagrams the results representing the diurnal characters of wind vector are plotted. In their conclusions the authors point out how their theory differs from existing theories; also the difficulty in making a direct test by comparison with observations. They consider that the theory explains more minutely than hitherto the tendency towards clockwise rotation of the wind, and also that it will assist in the reduction of pilot balloon observations. A. E. M. G.

2359. Cyclones in Bay of Bengal. S. N. Sen. *Science and Culture*, 3. *pp.* 458–461, *March*, 1938.—Three air masses are involved (*a*) cold, from the north; (*b*) moist, from the south-east trades and south-west monsoon; (*c*) warm, and only slightly moist westerly drift from the thermal equator. The movements and convergence of these air masses are considered. Attention is mainly confined to trajectories between 2-3 km. above sea level. Two characteristic seasonal fields A and B are drawn, called the general deformation fields. The behaviour of the air masses within these fields is then discussed at length. A table gives the percentage frequency of cyclones in both the Arabian Sea and the Bay of Bengal. The latter shows a maximum at the height of the monsoon when field B is established. The main sources of instability contributing towards the formation of cyclones are referred to, while it is pointed out that in the movement of the cyclone the motion is along the moist air trajectories. Factors contributing to the intensification of cyclones are summarised. A. E. M. G.

2360. Cloud Forecasting: Daily Use of the Tephigram. R. M. Poulter. *Roy. Meteorolog. Soc., J.* 64. *pp.* 277–288; *Disc.*, 289–292, *April*, 1938.—For air-survey work and other specialised daylight flying it is important to know for some hours ahead in fine weather the amount of the sky that will be covered by cloud and the height at which the cloud will exist. Readings of the dry- and wet-bulb thermometers at 50 mb. intervals provide information which, when plotted on a tephigram or similar diagram, enables a forecaster to predict with useful accuracy the amount, height and thickness of clouds during the day. Temperature and dew-point at 4 ft. in the forecast area and the probable rise of temperature are required to give the height of potential condensation, while the relation between the condensation temperature and the temperature of the environment is the criterion for cloud formation. Cloud thickness is judged by the relation between the saturation adiabatic through the condensation point and the actual temperatures above, while cloud amount is estimated by the relative humidity of the environment at the condensation level. The application of this technique to the various situations met in day-to-day forecasting is described and illustrated. AUTHOR.

2361. Saturated-Adiabatic Ascent of Air through Dry-Adiabatically Descending Environment. J. Bjerknes. *Roy. Meteorolog. Soc., J.* 64. *pp.* 325–330, *April*, 1938.—This paper gives a theoretical treatment of the cumulus convection in an atmosphere with a temperature lapse-rate between the saturated-adiabatic and the dry-adiabatic (conditional instability). The dry-adiabatic downward motion of the air between the clouds is taken into account. The result is that the cumulus convection does not convert heat into kinetic energy unless the ratio between the width of the cumulus towers and that of the cloudless intervals is below a certain critical value. Quite generally, the present treatment shows that the rate of production of kinetic energy through convection must be far below the estimates based on the assumption of the " infinitely small particle rising through an environment at rest." AUTHOR.

2362. Instability from Water Vapour. C. W. B. Normand. *Roy. Meteorolog. Soc., J.* 64. *pp.* 338–340, *April,* 1938.—Corrections to the original paper [see Abstract 1084 (1938)] and a reply to the discussion.

2363. Atmospheric Turbidity and Vapour Pressure near the Earth. D. Bidasio. *Com. Geod. e Geofis., Boll.* 7. *pp.* 241–246, *Oct.,* 1937.—The measurement of the turbidity of the atmosphere is obtained from observations at Conegliamo 1934–36, by measuring the radiation with an Ångstrom-Volochine pyrheliometer and computing the turbidity T by Linke's relation. T is shown to vary as the vapour pressure e near the earth and also to depend on the atmospheric mass. After correcting for the effect of mass, the equation $T = 2 \cdot 56 + 0 \cdot 08\, e$, is seen to be independent of altitude as it agrees with results by other observers at different stations, at least over the period of time considered. H. M. B.

2364. Fog Coronæ on the Puy de Dôme. J. Bricard. *Comptes Rendus,* 206. *pp.* 1036–1038, *March* 28, 1938.—A brief description is given of the apparatus used, consisting of a projector, a photographic apparatus and plates on which the fog particles are collected. The effects of drops having radii ranging from 3μ to 11μ have been examined, and the patterns obtained according to the radii of the particles, are enumerated. Curves of blackening are drawn for drops with radii less than 8μ, and greater than 10μ. These show that with red light with maximum at $0 \cdot 7\mu$, the effects are different in the two cases. The author hopes to continue the investigation in regions where the radii are greater than 11μ. A. E. M. G.

***2365. Hygrometry. Part II. H. Ebert.** *Die Physik,* 6. 2. *pp.* 47–54, 1938.—The paper is a Bibliography of the subject in the years 1934–37. It opens with a general theoretical review, followed by a discussion on air/moisture relationships. Methods of measurement of the degree of atmospheric humidity are followed by a survey of the importance of the subject to physics, technology and meteorology. Air conditioning apparatus is reviewed as a concluding note. [For Part I see Abstract 3220 (1934).] S. G. B.

2366. Oxford Expedition to North East Land, 1935–36. R. A. Hamilton. *Roy. Meteorolog. Soc., J.* 64. *pp.* 241–251 ; *Disc.,* 251–252, *April,* 1938.—The Expedition maintained a station for a year at 80° 23′ N. 19° 31′ E. on the NW. coast of North East Land, and other stations for shorter periods on the west coast and on the ice cap in the interior of the country. This paper gives monthly means and extreme values of the usual meteorological elements, as observed at these various stations together with a general comparison between them. Although there is reason to believe that the winter was an unusually mild one, the observations seem to disprove the tradition of continual gales, a wind velocity of 12 to 14 m.p.h. being maintained during the dark time. Sudden large fluctuations in temperature occurred in the winter and spring, changes of 30° F. being recorded in one day. In spite of the high latitude, temperatures above 15° F. were recorded during every month of the year. An almost constant feature of the summer weather was the mist which enveloped the ice-cap station (1,700 ft.) and which was usually observed about 300 ft. up on the hills near the Base Camp. AUTHOR.

2367. British East Greenland Expedition, 1935–36, at Kangerdlugssuak. G. Manley. *Roy. Meteorolog. Soc., J.* 64. *pp.* 253–276, *April*, 1938.—Conclusions are reached with regard to the meteorological characteristics of the region, notably the occurrence of fjord gales and precipitation. It is hoped that the general discussion of this excellent set of observations will be of value to others working on the problems of Greenland meteorology. Maps and photographs will be found, accompanying the general account of the expedition, in the *Geographical Journal*, 90, Nov., 1937.

2368. Polarisation of Sky Light Close to the Sun. W. M. Cohn. *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 155–160, 1938. *In English.*—The polarisation of sky light between 42′ and 65′ distance from the sun's limb was determined photographically during the 1932 and 1934 total solar eclipses. Exposures were obtained by means of polarigraphs in integrated light, and in the violet, blue, and red parts of the spectrum (3860–6870 Å). The sky light was found to be unpolarised over the entire wave-length region investigated. AUTHOR.

2369. Twilight Phenomena during Total Solar Eclipses. F. Link. *Comptes Rendus*, 206. *pp.* 1135–1137, *April* 4, 1938.—The passage of the moon's shadow over the surface of the earth gives rise to twilight phenomena. The paper is concerned with the component of the observed brightness at any point in the sky which is due to primary diffusion from atmospheric layers outside the moon's shadow. A mathematical discussion, assuming that the density ρ of the atmosphere varies with the altitude z thus :— $\rho = \exp(-\beta z)$, shows that the relative variation of brightness at central eclipse is a simple function of β. Consequently the density gradient in the upper atmosphere can be determined from the rates of change of brightness at various points in the sky. The variation of brightness with direction is also considered, and it is shown that observations of this quantity during the partial phase, as well as at totality, may be made to yield a value of β. A. Hu.

2370. Intensity Variations of the D Lines in the Twilight Sky. R. Bernard. *Comptes Rendus*, 206. *pp.* 1137–1140, *April* 4, 1938.—Spectrograms are reproduced to show the rapid fall in the intensity of the D lines of Na [see Abstract 1552 (1938)] at twilight. A suggestion that the D lines were observed during the Polar Year by Currie and Edwards [see Abstract 4624 (1936)] is considered unlikely, as the band then obtained at λ5940 is too far away from and bears no resemblance to the Na lines. It is suggested that the origin of this band is in the enhancement in the orange region of the twilight or lunar continuous spectrum by the sharp sensitivity maximum of the plates used. The band λ3711 of the second positive system of N_2 is also considered to be enhanced in moonlight simply by a photographic pre-sensitisation effect. On auroral spectrograms the band at λ5940 is attributed to a band of the first positive system of N_2 and is to be distinguished carefully from the Na lines. A. Hu.

2371. Auroral Display of Jan. 25–26, 1938. E. W. Barlow, S. Chapman, G. Simpson and J. Evershed. *Roy. Meteorolog. Soc., J.* 64. *pp.* 215–221, *April*, 1938.

2372. Auroral Region Temperature. L. Vegard and E. Tønsberg. *Geofysiske Publ.* 12. 3. [9 *pp.*], 1938. *In English.*—Two spectrograms of the nitrogen bands appearing in the auroral spectrum have been obtained. Intensity measurements have been made on the R-branch of the 4278 band and, applying band theory to these measurements, estimates of the gas temperature of the auroral region have been made and give the figure of approximately −35° C. This is in good agreement with the figures got from other methods. It is to be noted that the band lines are not resolved and that an intensity contour of the branch is used, the intensity being measured at points corresponding to definite R-lines and a correction applied for overlapping. A. H.

***2373. Aerological Height Computator. E. G. Bilham.** *Meteorolog. Office, Prof. Notes, No.* 80. [13 *pp.*], 1938.—The theoretical relations on which the instrument is based are first stated. The author then points out how observations made on aeroplanes can be adapted for use. Practical application is made and the principle of the method demonstrated. A discussion of the actual instrument and of its manipulation follows, while the various errors that can arise are considered. Other uses of the instrument are also referred to. As the original form was suitable for determination of heights up to 24,000 ft. only, a description of a later model with greatly extended range is given. The paper contains a line diagram and illustration of the instrument. A. E. M. G.

***2374. Snow Gauge, Instrument and Method. G. Crestani.** *Com. Geod. e Geofis., Boll.* 7. *pp.* 211–217, *Oct.*, 1937.—A cylindrical snow gauge has a knife as its lower edge, the diameter of which is 71 ± 0·1 mm.; this pierces the snow, and takes a sample in the cylinder. The balance for weighing the snow is correct to 4 gm. and the scale to 0·5 cm. Thus the errors in measurement of the water equivalent and the density of the snow are less than in other methods of measuring precipitation. A description is given of the form of knife used, the type of balance and the preparation of the ground before the snow falls. Comparison is made with a larger type of apparatus and any apparent loss in accuracy is seen to be compensated by the more efficient working of the smaller type and the greater ease in handling. The apparatus was used during the winter 1935–36, under various conditions of slope and exposure to wind and sun. H. M. B.

See also Abstracts 2351, 2352, 2379, 2380, 2627, 2628.

SEISMOLOGY.

***2375. Dynamic Damper for Seismic Structural Vibration. K. Kanai.** *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 21–29, *March*, 1938. *In English.*—In the present case the effectiveness of the seismic vibration damper in the case of irregular vibrations is shown; and also that the vibration of the model structure agrees with the law of forced vibration of simple harmonic type. [See Abstract 5288 (1937).] C. A. S.

2376. Origin of Earthquakes. Part V. W. Inouye. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 125–130, *March*, 1938. *In English.*—As a result of further mathematical investigation of the forces producing earthquakes it is concluded that seismic waves may result from change in the stress in the elastic medium around the seismic focus due to plastic yielding within the focus under the action of external forces. [For Parts III and IV see Abstract 5290 (1937).] C. A. S.

2377. Aftershocks and Periodicity in Earthquakes. H. Jeffreys. *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 111–139, 1938. *In English.*—It is shown that any tendency of earthquakes to stimulate one another after short intervals of time will lead to an increase of the random amplitudes expected to be obtained in a Fourier analysis, and that this

may explain the apparent periodicities found when the test of significance used assumes that the earthquakes are independent occurrences and the data include aftershocks. In the aftershocks of the Tango earthquake of 1927, March 7, no sign of mutual dependence is found, except that upon the main earthquake and its strong successor on April 1 the frequencies falling off with time in a way consistent with a regular law of chance depending only on the times since these two earthquakes. No amplitude found for any periodicity superposed on this variation provides any evidence for its genuineness. It appears that if any periodicities in earthquakes exist they would be best sought in earthquakes from new epicentres.
AUTHOR.

2378. P′ and the Earth's Core. B. Gutenberg and C. F. Richter. *Roy. Astron. Soc., M.N., Geophys. Supplement,* **4.** *pp.* **363–372,** *May,* **1938.**—Waves formerly identified as diffracted P′ can be accounted for more satisfactorily as ordinary refracted waves, provided that the velocity distribution within the core is assumed to be as follows: velocity increasing from about 8 km./sec. at the inside surface of the core to about 10·2 km./sec. about 1950 km. deeper, where there is a rapid but probably continuous increase with depth, the velocity reaching 11·4 km./sec. within 300 km., then decreasing slowly to 11·3 km./sec. at the centre. This hypothesis is better in accordance with the occasional large amplitudes. The modified velocity distribution requires two additional reversals in the travel-time curve, which accounts for peculiarities in the observations of P′ near the focal distance (which remains unchanged at 142°). It also accounts for similar observations of SKP and P′P′, and is consistent with the observations of other waves passing through the core. AUTHORS.

See also Abstract 2354.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2379. Solar Radiation and the Electric Charge of the Earth. G. Petrucci. *Com. Geod. e Geofis., Boll.* **7.** *pp.* **228–237,** *Oct.,* **1937.**—The author puts forward the hypothesis that the electric charge of the earth is caused by the photoelectric effect of the solar radiation on the atmosphere near the earth's surface. The ionisation of the air by u.v. radiation is greatly increased by the presence of impurities as dust particles, smoke, organic vapours, etc. From known data of the intensity and spectral distribution of the solar radiation, the number of emitted photoelectrons and the number of dust particles in the air the author calculates approximately the intensity of the photoelectric effect and comes to the conclusion that the order of magnitude of the effect is sufficient to explain the stability of the electric charge of the earth. [See following Abstract.]
L. K.

2380. Solar Radiation and the Terrestrial Electric Field. G. Petrucci. *Com. Geod. e Geofis., Boll.* **7.** *pp.* **238–240,** *Oct.,* **1937.**—The author publishes curves showing the annual variation of the u.v. radiation of the sun and of the electric field of the earth. Both variations show complete parallelism which constitutes a further proof for the author's hypothesis that the electric field of the earth is due to the photoelectric effect of the solar radiation on the terrestrial atmosphere. [See preceding Abstract.] L. K.

2381. Modern Views on Atmospheric Electricity. F. J. W. Whipple. *Roy. Meteorolog. Soc., J.* **64.** *pp.* **199–213,** *April,* **1938.** *Presidential Address.*—The central theme of the address is the circulation of electricity through the atmosphere. Clouds from which precipitation is falling act as generators of electricity. Recent work by Simpson and Scrase [see Abstract 3499 (1937)] supports the view that the separation of positive and negative electricity is mainly due to the impact of snow particles in the upper parts of the clouds. The snow particles carry negative electricity downwards and a current of positive electricity flows upwards to the " Heaviside layer " to come down again in distant places where fine weather happens to prevail. AUTHOR.

2382. Thunderstorm Rain and Earth's Negative Charge. S. K. Banerji. *Roy. Meteorolog. Soc., J.* 64. *pp.* 293–299, *April,* 1938.—At Bombay thunderstorms invariably move overhead in some east–west or west–east direction according as they are " heat " thunderstorms or " line-squall " thunderstorms. An analysis has been made of the charge brought down by rain during the passage of 23 thunderstorms over Bombay in the years 1930–32. During 1930–31, nine thunderstorms transferred to each sq. cm. of ground 0·52 E.S.U. of positive charge and 0·75 E.S.U. of negative charge, and during 1931–32 fourteen thunderstorms transferred to each sq. cm. of ground 0·59 E.S.U. of positive charge and 1·46 E.S.U. of negative charge. Therefore, the 23 thunderstorms, collectively transferred to each sq. cm. of ground 1·11 E.S.U. of positive charge, and 2·21 E.S.U. of negative charge. Estimating that an area of (100 km.)^2 received charge at the rate recorded at Bombay, it is concluded that on the average each thunderstorm transferred to the ground an excess of about 2×10^3 coulombs of negative electricity. [See also Abstract 3857 (1932).] AUTHOR.

2383. Progressive Lightning. Part V. B. F. J. Schonland, D. B. Hodges and H. Collens. *Roy. Soc., Proc.* 166*A*. *pp.* 56–75, *May* 4, 1938.—In a large number of lightning discharges the luminous phenomena were recorded by the Boys camera, and in some 71 cases (some simultaneously with the record of the luminous phenomena) the primary electrical process that caused them was examined by observing the changes in the electric field during the discharge by means of a kathode-ray oscillograph. The results are described in considerable detail, and generally support the views previously put forward by the authors. [For Part IV see Abstract 132 (1938).] C. A. S.

2384. American Magnetic Character-Figure C_A for 1937. A. G. McNish and H. F. Johnston. *Terr. Mag.* 43. *pp.* 49–54, *March,* 1938.—The American character-figure C_A, a new measure of magnetic activity, was inaugurated on March 13th, 1937, and on completion of its first year of use the occasion is taken to study the measure and appraise its significance. The figure is the mean of the assignments made to each Greenwich half-day on a scale of 0·0, 0·5, 1·0, 1·5 and 2 by seven American-operated observatories. Correlation coefficients are computed and tabulated for each quarter and each observatory, and the mean character-figure is found for each month. The monthly mean values are shown in a number of diagrams. The American figure is compared with the international one. The latter shows greater sensitiveness to variations in activity among comparatively quiet days, whereas the American figure shows greater sensitiveness to variations among highly disturbed days. The American figure for each half-day of 1937 is plotted according to periods of solar rotation. The 27-day interval of recurrence of magnetic disturbances was not very marked. [See also Abstract 3988 (1937).] G. E. A.

See also Abstracts 2352, 2419.

RADIOACTIVITY.

2385. Radioactivity of Mineral Springs. H. Pertz. *Akad. Wiss. Wien, Ber.* 146. 2*a*. 9–10. *pp*. 611–622, 1937.—The radioactivity of 12 springs, all along the line of fracture running south from Vienna through Baden, was measured. That of the six springs at Baden itself was much the greatest (Em 5·4–7·2 ME, Ra 4·0–7·0 × 10^{-12} g./l., Th 0·1–0·17 × 10^{-5} g./l.); the radioactivity of the other springs—those of Vöslau, Villach, Fischau and Meidling—was in no case more than ¼th of that of the Baden springs, but yet roughly 10 times that of Vienna tap water. Details of methods of determination, etc., are given. C. A. S.

2386. Radioelement of Period 3·5 Hours Formed from Uranium Irradiated by Neutrons. I. Curie and P. Savitch. *Comptes Rendus*, 206. *pp*. 906–908, *March* 21, 1938.—The element with period 3·5 hr. formed in addition to the transuranium and other elements on bombarding U with neutrons is shown by chemical tests to be separable from UX and to be definitely not an isotope of Th, but to have properties similar to those of a rare earth. It is therefore probably an Ac isotope. C. A. S.

2387. Disintegration Periods of the Radio-Silvers. A. Moussa and H. Laurent. *Comptes Rendus*, 206. *pp*. 1015–1017, *March* 28, 1938.—Experiments are described which show that Amaldi's periods [see Abstract 4757 (1937)] for the radioactive silvers produced by bombardment of the metal with slow neutrons are too low, and should be 24 ± 2 sec. and 158 ± 10 sec. instead of 22 sec. and 2·3 min. for ${}^{110}_{47}\mathrm{Ag}$ and ${}^{108}_{47}\mathrm{Ag}$ respectively. ${}^{106}_{47}\mathrm{Ag}$ with period 24·5 min., is found in only very small proportion when bombardment is with slow neutrons. C. A. S.

2388. Artificial Activity of Radio-Aluminium (${}^{26}\mathrm{Al}$) and Radio-Chlorine (${}^{34}\mathrm{Cl}$). H. Brandt. *Zeits. f. Physik*, 108. 11–12. *pp*. 726–738, 1938.—The transformations ${}^{23}_{11}\mathrm{Na}(\alpha, n){}^{26}_{13}\mathrm{Al}$ and ${}^{31}_{15}\mathrm{P}(\alpha, n){}^{34}_{17}\mathrm{Cl}$ have been investigated. A method of determining with accuracy the specific ionising power of single positrons is given. The excitation curves of ${}^{26}_{13}\mathrm{Al}$ and ${}^{34}_{17}\mathrm{Cl}$ are given, and the energies of the positrons emitted from the two radioactive nuclei have been determined. The half-life of ${}^{34}_{17}\mathrm{Cl}$ is 32·7 ± 3·7 min. The absolute probability of transformation in the two processes is determined. A. J. M.

2389. Comparison of Intensities of Various Radioactive Elements Produced by Slow Neutron Bombardment. A. Baschwitz. *J. de Physique et le Radium*, 9. *pp*. 123–124, *March*, 1938.—Using a tube counter, measurement is made of the various intensities of radioactive elements formed by bombardment with slow neutrons under standard conditions. A table is constructed giving the intensities obtainable from 19 elements. F. C. C.

2390. Disintegration of Boron by Slow Neutrons. J. C. Bower, E. Bretscher and C. W. Gilbert. *Cambridge Phil. Soc., Proc.* 34. *pp*. 290–295, *April*, 1938.—Photometrical measurements of the photographic images of cloud tracks of the disintegration of B by slow neutrons, ${}^{10}_{5}\mathrm{B} + {}^{1}_{0}n \rightarrow {}^{7}_{3}\mathrm{Li} + {}^{4}_{2}\mathrm{He}$, have enabled the ranges of both the He and the Li particle to be determined. It is found that the He particle has a range of 7·0 ± 0·3 mm. and the Li particle a range of 4·3 ± 0·2 mm. in standard air. It is deduced that the ${}^{7}\mathrm{Li}$ nucleus is usually formed in an excited state, with energy of excitation of either 0·5 or 0·8 eMV. The wide latitude in excitation energy is due to the uncertain state of our knowledge of the energy-range relation for α-particles. AUTHORS.

2391. Fast Neutrons. M. L. Pool. *Phys. Rev.* 53. *pp.* 707–710, *May* 1, 1938.—The distribution of fast neutrons about the Li + D source has been investigated by means of radioactivity induced in Ag (24·5 min.) and Al (14·8 hr.). The observations are roughly in agreement with a distribution calculated from statistical considerations. The maximum neutron energy is 20·8 eMV. An increase in the deuteron energy results in an increase in the neutron energy as measured by the $n-3n$ reaction of Sc and the $n-2n$ reactions of Ag and Cu. The intermediate nucleus, Be^9, formed by the deuteron bombardment of Li must have a life short compared with 10^{-12} sec. A number of materials when bombarded with high energy deuterons yield neutrons of sufficient energy to produce the $n-2n$ reaction in Ag. Only the neutrons from Li can produce the $n-3n$ reaction in Sc. Neutrons of somewhat less energy are required for the $n-2n$ Cu reaction and of appreciably less for the $n-2n$ Ag reaction. When Sc is bombarded with fast neutrons, reactions of the type $n-3n$, $n-2n$, $n-\alpha$, $n-p$ and $n-\gamma$ take place in the following percentages, 24·0, 27·8, 20·6, <0·5, and 27·0 respectively. AUTHOR.

2392. Formation of an Excited He^3 in the Disintegration of Deuterium by Deuterons. T. W. Bonner. *Phys. Rev.* 53. *pp.* 711–713, *May* 1, 1938.—The energy distribution of the neutrons from the reaction $H^2 + H^2 \rightarrow He^3 + n^1 + Q_1$ has been studied. Two homogeneous neutron groups with energies of 1·08 and 2·50 eMV have been observed at 90° to the 0·11 eMV deuterons. The emission of 1·08 eMV neutrons has been found to be approximately 1/10 as likely as the emission of 2·50 eMV neutrons. The corresponding values of Q_1 are $Q_1{}^0 = 3{\cdot}29 \pm 0{\cdot}08$ eMV and $Q_1{}^1 = 1{\cdot}40 \pm 0{\cdot}11$ eMV. The low energy group results when the He^3 is left excited to a level of 1·89 ± 0·11 eMV. The mass of He^3 has been calculated from the value of $Q_1{}^0$ and the mass-spectrographic value of $H^2 = 2{\cdot}01473$. The result is $He^3 = 3{\cdot}01700$. This result indicates that H^3 may spontaneously disintegrate into He^3 with the emission of an electron. AUTHOR.

***2393. Magnetic Field Corrections in the Cyclotron. M. E. Rose.** *Phys. Rev.* 53. *pp.* 715–719, *May* 1, 1938.—It is pointed out that in order to obtain magnetic fields which will allow the ions in the cyclotron to attain high energies it is first necessary to render the field homogeneous within an accuracy of about 1 part in 1000. The correction (insertion of "shims") for the most important source of inhomogeneity, namely the decrease in the field near the edge of the pole pieces, is considered. A general method is given for determining the dimensions for any shape of these shims. Results are given for the dimensions of shims in the form of a ring of rectangular cross section placed at the edge of the cyclotron chamber. The magnetic field resulting from the use of such shims is determined and compared with the field of plane parallel pole faces. For the special case of a ring whose thickness is 1/16 the magnetic gap, the field is homogeneous within the required accuracy up to a distance from the edge of the poles of 0·4 of the magnetic gap. The uncorrected field is homogeneous only up to a distance from the edge equal to 0·9 of the magnetic gap. [See also Abstract 1963 (1938).] AUTHOR.

2394. Cross-Sections for Reactions between Very Light Nuclei. S. Flügge. *Zeits. f. Physik,* 108. 9–10. *pp.* 545–579, 1938.—The scattering of protons and neutrons by deuterons, and the elastic and inelastic collisions between two deuterons are discussed theoretically on the assumption that the internal motion of the constituents of the deuteron can, during the collision, be separated from the motion of its centre of gravity. The results obtained in this way are very rough but seem to be in qualitative agreement with the experiment as regards cross-section and angular distribution. R. P.

2395. Dispersion Formula for Nuclear Reactions. P. L. Kapur and R. Peierls. *Roy. Soc., Proc.* 166*A. pp.* 277–295, *May* 19, 1938.—The dispersion formula of Bethe and Placzek [see Abstract 2307 (1937)] which expresses the cross-section for nuclear reactions in terms of the virtual levels of the compound nucleus and their widths, is derived without using the assumption that the motion of the incident particle within the nucleus can in any approximation be regarded as a one-body problem. It is possible to derive a formula of the type of the dispersion formula without any assumption at all about the mechanism of the reaction. However, in the general case this formula contains more parameters than the usual dispersion formula and is therefore of less practical value. The dispersion formula of Bethe and Placzek is shown to hold rigorously if only the widths of all virtual levels which contribute essentially to the expression are much smaller than the distances between the levels. AUTHORS.

2396. Numbering α-Particles by their Photographic Action. F. Halbwachs. *J. de Physique et le Radium,* 9. *pp.* 125–128, *March,* 1938.—After an account of the different characters of the impressions produced by α, β and γ-rays, details are given of the method best suited for α-particles, the most suitable plates and method of development, arrangement of the radioactive material when photographing, calculation of the result, and probable error (2½%). C. A. S.

2397. β-Spectra. M. Lecoin. *J. de Physique et le Radium,* 9. *pp.* 81–95, *March,* 1938.—An investigation has been made of the continuous β spectrum of several natural radioactive elements using the Wilson cloud chamber method. Stereoscopic photography of the rays has been employed on account of the greatly increased accuracy of measurement of the radii of curvature obtained by this method. The elements examined were: RaE, $UX_1 + UX_2 + UZ$, UX_2, UZ, MTh_2, AcB, AcC″, and RaC″. The spectrum of RaE was determined with great accuracy; the form found differed appreciably from previous results. A comparison of the experimental results has been made with the Konopinski-Uhlenbeck theory according to the procedure indicated by Kurie. The diagrams thus obtained are rectangular with the exception of that for UX_2. For comparison amongst themselves of different spectra and for the study of the relation between λ and the continuous spectrum, it is proposed to use the mean energy E_m removed by disintegration. This energy can be determined easily and accurately by several methods. G. O. B.

2398. Directional Distribution in β-Decay. I. I. Predmestnikow. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 32–35, 1938. *In German.*—It is shown that the Möller-Bloch formula for the angular distribution of recoil atoms at a β-decay is independent of the charge of the decaying nucleus. The angular distribution does depend, however, on the change in angular momentum at the nuclear transition under consideration. Further, it is shown that at the inverse β-process at very high energies, the forward direction seems to be in no way preferred. G. O. B.

2399. Internal Conversion Electrons of Actinon. W. E. Bennett. *Cambridge Phil. Soc., Proc.* 34. *pp.* 282–289, *April,* 1938.—Actinium emanation was introduced into a cloud chamber for the purpose of making a study of the secondary β-rays. The energies were in agreement with those given by Surugue [see Abstract 4123 (1936)], using the magnetic spectrum method, except that his strong line at 105 kV was absent. By comparing the numbers of β-rays with the relative intensities of the groups of α-particles, measured by Rosenblum, it was found that the internal conversion coefficients were in general agreement with previous experimental values in the same region of energy. Tracks of Auger electrons associated with the secondary β-rays were found in the photographs. In general, the results from the cloud chamber method agreed with accepted theories and confirmed the results obtained by other methods. AUTHOR.

2400. Diffraction Spectrography of γ-Rays of Actinium and its Derivatives. M. Frilley. *Comptes Rendus*, 206. *pp*. 1013–1015, *March* 28, 1938.—This was examined by a method similar to that used for Ra and its derivatives [see Abstract 3588 (1929)]. The K fluorescence lines are intense, especially those of An. Agreement with the results deduced from β-ray spectra is good up to 125 X.U., but after that decreases, and above 175 X.U. is poor; the causes are discussed. C. A. S.

2401. Eve Constant. R. Schulze. *Ann. d. Physik*, 31. 7. *pp*. 633–660, *April*, 1938.—An investigation of the Eve constant has been made owing to the fact that amongst existing values there is a variation of some 30%. Since these variations arise from different interpretations of the definition of the Eve constant and from different calculations of the effects of filters, it was the object of these experiments to clarify the definition and the conditions of measurement. To this end the effect and magnitude of the scattering region for secondary β-and γ-rays were investigated. For measurements in air it was established that the β-scattering region must be at least 5mm. thick, and that the distance of the active material must be a multiple of the scattering region thickness. Ionisation chambers with walls of a sufficient thickness equivalent to a given thickness of air were used. The calculation of the weakening effect of the filters round the active preparation were carried out by a method due to Kohlrausch. The value obtained for the constant was $(5{\cdot}5 \pm 0{\cdot}1) \times 10^9$ ion pairs cm^{-1}. gm^{-1}. sec^{-1}. G. O. B.

***2402. Apparatus for Demonstrating Radioactivity. K. T. Bainbridge and J. C. Street.** *Am. Phys. Teacher*, 6. *pp*. 99–102, *April*, 1938.—Description of the construction and application of (1) a modified Schonland electroscope, (2) a valve electrometer, (2) a Geiger-Müller counter to demonstrate the radioactive properties of thoron. F. C. C.

***2403. Mains-Operated Spark-Counter. H. Greinacher.** *Zeits. f. techn. Physik*, 19. 5. *pp*. 132–134, 1938.—A description is given of a mains-operated unit for the detection of single ionising particles, incorporating the "spark-counter" previously described [see Abstracts 2962 and 3610 (1935)], with which indications are obtained without the use of any amplifying means. The working characteristics of the device are discussed. D.H.F.

***2404. High Resolving Power Tenfold Thyratron Counter. D. W. Kerst.** *Rev. Sci. Instruments*, 9. *pp*. 131–133, *April*, 1938.—The counter described has a resolving time of 5×10^{-4} sec. and uses one pair of thyratrons to give the desired scale factor. A circuit diagram and detailed description of the counter are given. Tests of the resolving power of the complete outfit, including the ionisation chamber and amplifier, were made. The count of α-particles from a small disc source in front of a circular hole in the ionisation chamber was plotted against the solid angle subtended by the hole, and the theoretical counts for different resolving powers were plotted on the same graph. While the sensitivity of the method is not great, the coincidence of the theoretical curve for a resolving time T of 5×10^{-4} sec. and the experimental curve indicates the approximate value of T for the apparatus. A. W.

***2405. Multiple Coincidence Detector. S. Gorodetzky.** *Comptes Rendus*, 206. *pp*. 900–902, *March* 21, 1938.—A common method of detecting the simultaneous occurrence of ionisation in a number of ionisation-chambers is to connect each electrode to the grid of a separate valve, the valve anodes being connected to a high resistance R, and the filaments being earthed. At the instant of a multiple coincidence the current through all the valves is cut off and the anode potential increases provided R is large compared with the internal resistance of the valves, *i.e.*, R is about 8 MΩ. The author discusses this circuit and suggests a modified arrangement, for which advantages of increased sensitivity and stability are claimed. In this arrangement by the use of high resistance pentodes a lower resistance, R, can be used, 0·2 MΩ being sufficient. K. M. C.

***2406. Accidental Coincidences in Counter Circuits. C. Eckart and F. R. Shonka.** *Phys. Rev*. 53. *pp*. 752–756, *May* 1, 1938.—The accidental n-fold coincidences ($n > 2$) are of various kinds. The first kind involves n events that accidentally occur nearly simultaneously. The second kind involves two events that are causally simultaneous, and $n-2$ events that are accidentally nearly simultaneous; etc. For theoretical purposes, it is sufficient to treat only accidentals of the first kind, since the theory of the other kinds is very similar. It is also possible, for theoretical purposes, to replace each of the various coincidence circuits in actual use by the same schematic circuit. This consists of three parts: the counting, relay, and recording circuits. For n-fold coincidences, the relay circuit will contain n relays (*e.g.*, type 57 tubes). It is shown that the time constants (τ_i) of these relays determine the accidental counting rates. The time constants of the counting and recording circuits are not important in this connection. It is shown experimentally that each of the relays ordinarily has a different time constant, τ_i, even though it is constructed of commercially identical parts. By the use of these results, it is shown that when N_i particles per second traverse the ith counter, the rate at which accidentals of the first kind occur is given by

$$A_{1, 2, \cdots n} = BC, B = N_1\tau_1 \cdot N_2\tau_2 \cdots N_n\tau_n, C = 1/\tau_1 + 1/\tau_2 + \cdots + 1/\tau_n.$$

The rates of occurrence of the other kinds of accidentals are readily deduced from this result by slight modifications. This formula is verified by experiment. AUTHORS.

***2407. Radially Expanding Cloud Chamber. F. Trey.** *Phys. Zeits*. 39. *pp*. 343–344, *April* 15, 1938.—The advantages of the radially-expanding type of cloud chamber are discussed briefly and the constructional details are given of such a chamber. Among their merits is their small size; chambers of 4 and 8 cm. dia. have been made, and been found satisfactory in use. C. J. B. C.

***2408. Simple Wilson Chamber for Demonstration. G. Rathenau.** *Physica*, 5. *pp*. 427–429, *May*, 1938. *In German*.—Constructional details and diagram of a simple, spring-driven Wilson chamber for laboratory demonstrations. F. C. C.

See also Abstracts 2552, 2591, 2592.

RADIATION.

ABSORPTION.

***2409. Design of Monochromatic Filters for Mercury Vapour Lamps. E. M. Staats.** *J.O.S.A.* 28. *pp.* 112–120, *April,* 1938.—The high intensity and unique form of the type H-3/Hg vapour lamp have made this lamp adaptable to many problems, and justify a further consideration of Hg monochromats. There is, however, no one method of design which can be generally adopted, as the monochromat requires a choice of glasses and thicknesses to achieve what is at best a compromise, and gives the highest purity permitted by the energy distribution of the source and the spectral response of the receiver. The filter glasses, of which there are usually two, are selected by considering the steepness of the slope of their transmission curve near the desired wavelengths, and their opacity in the adjoining regions. The thicknesses are then varied to give the best values of transmission and purity, the best thickness ratio being found by calculation of the purities of several combinations which are arranged to give constant transmission at the desired wavelength. Curves are given showing the best values of purity and transmission for various source-filter-receiver combinations for different wavelengths. R. C. F.

See also Abstract 2442.

COLORIMETRY.

2410. Photometric Relationships between Complementary Colours. D. L. MacAdam. *Kodak Research Lab., Comm. No.* 659. *J.O.S.A.* 28. *pp.* 103–111, *April,* 1938.—From a brief discussion of the definition of complementary colours, it is shown that there is only one of several alternative definitions which is sufficiently specific to permit the solution of the general problem of colorimetric specification of all the possible complementaries of any colour. With regard to the photometric relationships between complementary colours, two complementary chromaticities must be additively mixed in the proper brightness ratio in order to produce a neutral mixture. This ratio can be calculated from any one of three expressions in which the coordinates of the complementary chromaticities in the I.C.I. chromaticity diagram are used. Other sections dealt with are the vector solution of problems of additive colour mixture, complementary relations between colours having maximum visual efficiencies, and, finally, formulæ and tables are given for interconversion of colorimetric and excitation purities. R. C. F.

2411. Minimum Perceptible Colorimetric Purity as a Function of Dominant Wave-Length. I. G. Priest and F. G. Brickwedde. *Bureau of Standards, J. of Research,* 20. *pp.* 673–682, *May,* 1938. *J.O.S.A.* 28. *pp.* 133–139, *May,* 1938.—A 4° square, two-part photometric field, symmetrical about a vertical division and viewed through a pupil 3 mm. in dia., is illuminated in both parts by artificial sunlight at a constant brightness of about 3 or 4 mL (retinal illumination, 70 to 90 photons) with a surrounding field of about 0·5 mL. Homogeneous light is added to one-half, and sunlight simultaneously subtracted so that the field remains matched in brightness. Two adjustments of the mixture are made: (1) The least purity perceptible with certainty (p_{max}), and (2) the greatest imperceptible purity (p_{min}). The purity of these mixtures is then measured, increased accuracy being obtained by measuring a known large multiple of the homogeneous brightness. Values of p_{max} and

$p_{\min}$ have been obtained as a function of the wavelength of the homogeneous component; these values are reported in detail, and some discussion of their interpretation is given. AUTHORS.

***2412. Trichromatic Colorimeter. M. Richter.** *Zeits. f. techn. Physik.* 19. 4. *pp.* 98–103, 1938.—Describes the construction and use of a new trichromatic colorimeter developed to reduce the known physiological and apparatus errors. R. C. F.

2413. Determination of Phosphate by Photoelectric Colorimetry. W. J. Dyer and C. L. Wrenshall. *Canad. J. of Research,* 16. *Sect. B. pp.* 97–108, *March,* 1938.—A sensitive and accurate method for the determination of phosphate, involving the application of the Evelyn photoelectric colorimeter to the ceruleomolybdate reaction, is described. This technique makes it possible to differentiate phosphate phosphorus from other forms of phosphorus. Conditions affecting the rate and extent of colour development have been studied. The results show that the maximum colour intensity is developed in about 5 min. after addition of the reducing agent. The determination may be made in the presence of extraneous colour, and soil organic matter does not interfere with the reaction. Under the conditions specified, using light filters, Beer's law applies to the reaction in soil extracts as well as in pure solutions in the range 0·02 to 0·40 p.p.m. of phosphorus. AUTHORS.

EMISSION.

2414. Critical Velocity in the Materialisation of the Photon. S. A. de Mayolo. *Comptes Rendus,* 206. *pp.* 988–990, *March* 28, 1938.—Some consequences of the author's hypothesis that the materialisation of a photon depends on the existence of a critical velocity proportional to the fine structure constant, are worked out. G. C. McV.

2415. Three-Dimensional Case in the Neutrino Theory of Light. Part II. A. Sokolow. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 36–46, 1938. *In German.*—In a continuation of some earlier work [see Abstract 5322 (1937)] an attempt is made to extend the neutrino theory of light to three dimensions. The analysis leads to the conception of a specific neutrino "charge." G. O. B.

2416. Intensity Distribution in the White Light of Electrically Excited Xenon. F. Gans. *Comptes Rendus,* 206. *pp.* 1009–1011, *March* 28, 1938.—The continuous spectrum of Xe was excited by discharging a condenser through a tube containing the gas in series with a thyratron. The intensity distribution of the spectrum was measured by photographic photometry. [See Abstract 1192 (1937).] In the region studied (4000 to 5700 Å), the intensity distribution is approximately the same as for a black body at 3800° K. The colour of the discharge varies with the tension per unit length of the positive column; with increasing tension, the colour becomes more blue. The lines appearing on the continuous background are the lines of the arc spectrum of Xe. A mixture of Xe and Ne shows only the Xe lines. The disappearance of the Ne lines is attributed to collisions of the second kind. L. K.

2417. Radial Inhomogeneity in Emission from an Indirectly Heated Hg Discharge Tube. E. Fischer and H. König. *Phys. Zeits.* 39. *pp.* 313–316, *April* 1, 1938.—Previous observations [see Abstract 5320 (1937)] have shown that considerable variations occur in the spectral energy distribution from a Hg arc, when light is taken from different parts of the tube. In the present work detailed investigations have been made on the changes in intensity of the line and continuous spectra, as the point of observation is moved from the axis to the wall of the tube. In the case of the line spectra there is a continuous falling off in intensity of all lines as the tube wall is approached. A series of "half-value distances" is obtained for a number of lines, the "half-value distance" being the distance from the axis at which the intensity of the line falls to half the axial value. It is shown that there is a close correlation between this distance and the excitation energy of the line in question. The resonance line 2537 Å has the largest "half-value distance," the value decreasing until it is almost constant for the higher energy lines. An interpretation of the results is suggested, in terms of the radial distribution of temperature and vapour pressure in the tube, the possible re-absorption of radiation being also considered. Similar experiments were also carried out on two regions of the continuous spectrum. In the case of the region of 3300 Å the intensity reaches a maximum at the wall as well as on the axis. These results are interpreted on similar lines to those for the line spectra. J. E. R.

***2418. Isochromatic Energy Curves for a Black Body in the Region 2800–3060 Å. I. L. Roich.** *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 11–22, 1938. *In German.*—An apparatus is described for determining the isochromatic u.v. energy curves by the use of a Pt-H_2 light counter. Light of a given wave-length is selected by means of a quartz monochromator and is then focussed on to the light counter; the number of impulses per minute gives a measure of the energy. A black body is used as a source and the apparatus is so sensitive that it is possible to work at temperatures low enough to be measured with a thermocouple. The results are in agreement with those deduced from the Planck-Wien law. The value of the radiation constant may be derived from the results and a value of 1430 ± 0·007 is obtained. [See also Abstract 4560 (1935).] H. J. H. S.

2419. Magnetic Storm and Variation of Cosmic Rays. J. Clay and E. M. Bruins. *K. Akad. Amsterdam, Proc.* 41. 3. *pp.* 215–216, 1938.—The ionisation records in three chambers, two under 110 cm. Fe shields and one under 12 cm. Fe, obtained during the magnetic storm of Jan. 24–26, all show an initial increase in ionisation followed by a decrease, the percentage variation being greater under the smaller shield. An unexplained difference in the magnitude of the variation between the other two chambers is found. [See also Abstract 1145 (1938).] D. H. F.

2420. Direct Photographic Record of Cosmic Rays. T. Takéuchi and T. Sugita. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 221–222, *March,* 1938. *In English.*—Specially sensitive photographic plates were placed vertically between the poles of an electromagnet surmounted by a 6 cm. block of Pb. On developments after a fortnight, curved and straight tracks, attributed to cosmic rays, were detected on the plates. D. H. F.

2421. Rate of Production of Very Large Cosmic-Ray Bursts as a Function of Lead Shielding Thickness. W. P. Jesse and R. L. Doan. *Phys. Rev.* 53. *pp.* 691–693, *May* 1, 1938.—Experiments have been performed at Chicago with two Compton-Bennett cosmic-ray meters to determine the frequency of occurrence of very large bursts (120 to more than 1000 particles) as a function of lead shielding thickness. The thickness of lead for optimum burst rate was found on both meters to be in the neighbourhood of 3 cm. This is larger than the optimum for showers and small bursts, a fact which is in qualitative agreement with the theory of Carlson and Oppenheimer. Quantitatively, the maximum determined experimentally is of the same order of magnitude as that predicted by the theory though lower. AUTHORS.

2422. New Analysis of Cosmic Radiation Including the Hard Component. L. W. Nordheim. *Phys. Rev.* 53. *pp.* 694–706, *May* 1, 1938.—A representation of all known data on cosmic-ray intensities in their dependence on geomagnetic latitude and on altitude, respectively depth below sea level, has been obtained on the following assumptions: (i) A soft component consisting of electrons which follow the Bethe-Heitler theory up to the highest energies with a primary distribution E^{-n} (E = energy, *n* between 3 and 2); (ii) A hard component of different nature which in addition to normal ionisation is absorbed by a discontinuous process leading also to the production of numerous secondaries with a cross-section inversely proportional to E for high energies. The primary distribution in energy is about the same form as for the soft component, and also the absolute numbers of hard and soft primaries are of the same order of magnitude. This picture is furthermore well compatible with the Rossi transition curves for showers, and their occurrence below thick layers of heavy material and underground. AUTHOR.

2423. Hard Cosmic-Ray Showers. K. Schmeiser and W. Bothe. *Ann. d. Physik,* 32. 1–2. *pp.* 161–177, *May,* 1938—Using coincidence counters examination is made of the hard components in cosmic-ray showers. The dependence of the intensity of the hard components on the nature of the shower-producing materials is on Z rather than on Z^2. The hard and soft components of the showers are produced by the hard and soft components of the primary radiation. F. C. C.

2424. Cascade Theory of Electronic Showers. L. Landau and G. Rumer. *Roy. Soc., Proc.* 166*A. pp.* 213–228, *May* 19, 1938.—Starting from the physical idea proposed by Bhabha and Heitler and Carlson and Oppenheimer [see Abstracts 2076 and 1632 (1937)] on the cascade production of showers, a more rigorous treatment of the problem is given. A numerical table permits the calculation of the number of shower particles as a function of depth of penetration for any given initial energy of the creating particle, and also the energy distribution for shower particles at a given depth. The showers possess a definite range. The behaviour of a shower passing from air to a medium with a different atomic number is studied. The consequences arising from the hypothesis of the new "semi-heavy" particles are discussed. AUTHORS.

2425. Reduction of Scale Deflections in Radiometry. T. E. Sterne. *Harvard Coll. Obs., Bull. No.* 908. *pp.* 15–17, *March* 1, 1938.—The scale reading of the galvanometer or radiometer used in the measurement of radiation usually shows a more or less steady drift even when no radiation is being received. During a set of measures, the drift may occur at a constant rate, or it may contain quadratic or even higher terms in the time. It is necessary to allow for the drift and for random errors in reducing the measures. The Brownian motion of the moving system can never be avoided ; and in the measurement of minute amounts of radiation may well be the main source of random errors. To free the measures to the greatest possible extent from the effects of such drift and random errors as may still remain after all practicable precautions have been taken, a simple method of reduction based upon least squares is outlined.

Formulæ are given for the removal of linear, or linear and quadratic, terms in the drift. A. Hu.

See also Abstract 2216.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2426. Growth and Decay of Phosphorescence in Calcium Sulphide by a Photoelectric Method. P. J. Mulder. *Frank. Inst., J.* 225. *pp.* 527–547, *May*, 1938.—The phosphorescence of the CaS was excited by light and the intensity of the combined radiation of all stimulated wave-lengths was measured as a function of time by means of a photo-cell, the current from which was amplified by a special valve amplifier. The amplified currents deflected a galvanometer, the deflection of which was found to be strictly proportional to the intensity of the light falling on the cell. Decay curves for different durations of excitation of the sample were obtained, the decay in intensity during the first 30 sec. after excitation being automatically recorded. Similar curves were obtained for identical durations of excitation at various temperatures of the sample. The effects of several different binders for the CaS powder were also investigated. A single empirical equation for sulphide in a given binder was obtained, by means of which the intensity of the phosphorescence can be computed for any time after excitation begins, and for any temperature within the range studied. AUTHOR.

See also Abstract 2213.

INTERFERENCE, DIFFRACTION AND SCATTERING.

See Abstracts 2531, 2532, 2533, 2534, 2535, 2536.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2427. Photodecomposition of CH_3I and C_2H_5I. W. West and L. Schlessinger. *Am. Chem. Soc., J.* 60. *pp.* 961–966, *April*, 1938.—The mechanism of the static photolysis of CH_3I and of C_2H_5I is studied. The chief products are methane, and ethane + ethylene, in the two cases respectively, but the presence of Ag metal causes CH_3I to yield mainly ethane, and increases the rate of the reaction fortyfold. The iodine yield can also be increased by the addition of high pressures of inert gas. These results are accounted for by a suitable reaction scheme. C. B. A.

2428. Action of Light on Photographic Emulsions. N. F. Mott. *Phot. J.* 78. *pp.* 286–292, *April*, 1938.—Modern wave-mechanical theory is employed to describe, mainly in qualitative terms, properties of the ionic crystal AgBr such as electrolytic- and photo-conductivity. Photographic "print-out" and latent image formation require impurities (Ag, Ag_2S) of higher work-function than AgBr by which photoelectrons are trapped and to which Ag^+ ions are thereafter attracted. Alternatively, electrons will pass from absorbed developer molecules to an Ag centre but not to AgBr; a similar mechanism will explain optical sensitisation. Solarisation is supposed due to the formation, with prolonged exposure, of a protective film of AgBr reformed from Ag and the escaping Br. To explain the failure of the reciprocity law it is supposed that electron liberation and recombination proceed simultaneously and that a minimum electron density in the conduction band is necessary for latent image formation; this minimum will be lower at lower temperatures. L. V. C.

2429. Fine Grain Developers and a Method of Determining Graininess. W. Reinders and M. C. F. Beukers. *Phot. J.* 78. *pp.* 192–196, *April*, 1938.—The relative graininess of a standard negative material processed in various developers was determined by estimating the degree of enlargement of negatives, upon a standard bromide paper, at which the enlarged prints showed equal graininess. The DIN step-wedge was used as subject, the negatives being exposed and developed to give equal density and equal γ; three degrees of enlargement were used, *viz.* 8·7, 12·5 and 18, the value giving equal graininess being obtained by averaging. Apparent graininess is greatest in the " middle tones " (positive reflection densities 0·5–0·65). For a negative of γ 0·7, Atomal, Kodak Ultrafine, Ultrafin S.F. and *p*-phenylenediamine showed lower graininess than metol-hydroquinone (M.Q.) and M.Q.-borax developers, but *p*-phenylenediamine required inordinately long development. The differences in graininess increased, the lower the γ value. L. V. C.

***2430. Dark-Room Illumination. A. van Kreveld and J. A. M. van Liempt.** *Physica*, 5. *pp.* 345–373, *May*, 1938. *In English.*—A study has been made of the requirements that dark-room lamps used in the developing of negatives, have to satisfy in point of quality. Firstly the sensitivity of the eye to contrasts under dark-room conditions was determined for the different colours from green to dark red. Secondly the sensitivity of different photographic emulsions has been measured through the whole visible spectrum. From these measurements the optimum light for orthochromatic and panchromatic emulsions has been computed. Further the energy of dark-room lamp causing an inadmissible decrease in photographic contrast, and from this the " quality " of an arbitrary dark-room lamp has been calculated. AUTHORS.

2431. Influence of Surface Active Anions and Kations on Halogen Silver Sols and Photographic Emulsions. Part II. A. Lottermoser and R. Steudel. *Kolloid Zeits.* 83. *pp.* 37–51, *April*, 1938.—Deals with the results of measurements of the taking up of surface-active alkylpyridine kations by AgI, in which an ultra-filtration method is used. [See Abstract 2001 (1938).] R. C. F.

2432. Anomalous Adsorption in Photographic Phenomena. Lüppo-Cramer. *Kolloid Zeits.* 83. *pp.* 83–86, *April*, 1938.—Anomalous adsorption plays an important part in the latent image reactions of synthetically produced photo-bromides which are more easily destroyed by Ag dissolving materials, the more Ag they contain. This is particularly the case with the Sterry effect, and the Albert reversal, but the bleaching with persulphate and other phenomena also come in the same category. R. C. F.

2433. Photography in the Exploration of the Universe. H. Spencer Jones. *Phot. J.* 78. *pp.* 178–191, *April*, 1938.—A semi-popular review of the methods by which stellar and extra-galactic distances have been determined, (i) Bessel's (visual) heliometer method, (ii) direct parallax measurements, applicable up to 400 light-years, (iii) the Cepheid-variable relation between distance and luminosity period carries the limiting distance within our galactic system to 30,000, and considering extra-galactic nebulæ (M31) to 870,000, light-years, (iv) observation of apparent line-of-sight velocities of nebulæ, to about 500 million light-years. Photography is essential in groups (iii) and (iv) and has very greatly speeded up work in group (ii). L. V. C.

***2434. Calibration of Photoelectric Exposure-Meters. G. Nidetzky.** *V.D.I.* 82. *pp.* 451–454, *April* 9, 1938.—After a discussion of the theory, the author describes the results of a calibration of six different types of photoelectric exposure-meters. The calibration was carried out for a range of brightness of the object extending from about 15 to 20,000 apostilb (approx. 0·5 to 700 c./ft^2.). It was found that the range of values of the calibration constant might be as great as 5 to 1 over this range of brightness. For most practical purposes, and with modern emulsions of wide latitude, this performance is satisfactory. J. W. T. W.

2435. Brightness-Distribution in Image-Plane of Photographic Objectives. K. Pritschow. *Phot. Indust.* 36. *pp.* 126–128, *Feb.* 9, *and pp.* 424–428, *April* 6, 1938.—The first part of the paper gives diagrams showing how the light reaching the edges and corners of the focal plane of a camera is reduced by the " vignetting " effect, by which not all the light passing through the front lens-component emerges from the assembly. In the second part, methods of examining this effect are described. Superposed upon this effect, which is minimised by use of low apertures, is the normal working of the " fourth-power law", $E_\alpha = E_0 \cos^4\alpha$. L. V. C.

See also Abstracts 2249, 2471, 2585.

PHOTOMETRY.

***2436. Photometry of Projectors. W. M. Hampton.** *Illum. Eng. Soc.* (*London*), *Trans.* 3. *pp.* 52–59; *Disc.*, 59–63, *April*, 1938.—This paper deals with the theory of candle-power measurement in the case of projection apparatus, the application of the inverse-square law, the effect of atmospheric absorption and the correction for stray light. The actual methods used for making the measurements are described; the quantities measured are either peak candle-power, candle-power distribution or total flux in the beam. In an *Appendix* there are typical calculations of the point of " cross-over " in the beam and of the correction for atmospheric absorption. In the *Discussion*, **E. W. Chivers** described a method of adjusting the focus by means of a " flashing " test. **J. W. T. Walsh** suggested measurements of candle-power by a telephotometer instead of illumination measurements at long ranges. J. W. T. W.

***2437. Influence of Vapours on the Spectral Sensitivity of Photon Counters. R. Audubert and J. Mattler.** *Comptes Rendus*, 206. *pp.* 1005–1007, *March* 28, 1938.—In continuation of their research on the spectral sensitivity of photon counters [see Abstract 2072 (1935)] the authors have studied counters which were filled with the vapour of ethyl alcohol instead of air or nitrogen. They find that counters with Pt, Au, Ag, Cu, CuO, CdS, Al are not influenced by the introduction of ethyl alcohol, but that in the case of CuI the maximum of the sensitivity curve is shifted from 2150 Å to 2350 Å, independently of the concentration of the alcohol. As the same shift occurs for counters filled with acetone, but not in counters with an I atmosphere, the authors conclude that this shift is due to a chemical influence of the ethyl-alcohol and acetone vapour on the CuI kathode as CuI is easily dissociated. Under this influence the kathode will show a slight excess of Cu on its surface. L. K.

See also Abstracts 2417, 2418, 2425.

POLARISATION.

***2438. Polarising Vertical Illuminator. L. V. Foster.** *J.O.S.A.* 28. *pp.* 124–126, *April*, 1938.—The author describes a new polarising vertical illuminator made of calcite which is an improvement on the plane glass type. It consists of two parts: these are made from one piece of calcite with the optic axis parallel to the end of the prism and in the plane of the cemented surface. The two parts are cemented together with a cement having approximately the same refractive index as the extraordinary ray. One side of the prism is painted black to absorb the ordinary ray after reflection, whilst the extraordinary ray passes through the prism and on to the specimen. It is claimed that this prism is about 4½ times as efficient as the plane glass reflector, and that there is no astigmatism present. The illuminating prism acts both as a polariser and an analyser. [See following Abstract.] R. L.

***2439. Polarised Vertical Illumination. L. V. Foster.** *J.O.S.A.* 28. *pp.* 127–129, *April,* 1938.—The author analyses certain limitations caused by placing a polariser between the light source and either the plane glass vertical illuminator or the various mirror illuminators. Reference is made to two devices for increasing the field of polarisation of reflecting vertical illuminators due to Berek and also to another vertical illuminator due to the author, consisting of a specially constructed calcite prism. With an improved form of this prism the full aperture of the objective is used for both the illuminating pencil of light and the image forming beam. It is stated that it has none of the limitations described in the earlier part of the paper. [See preceding Abstract.] R. L.

***2440. Testing Quartz Plates Cut at Right Angles to the Optical Axis. A. Biot.** *Ann. Soc. Sci. de Bruxelles,* 58. *pp.* 98–100, *March* 19, 1938.—By means of a conoscope it is possible to determine the error in the perpendicularity of plane parallel-sided quartz plates to an accuracy of 1′. H. G. C.

See also Abstract 2461.

REFLECTION, REFRACTION AND DISPERSION.

2441. Optical Properties of Thin Pt Films. P. Rouard. *Comptes Rendus,* 206. *pp.* 1106–1108, *April* 4, 1938.—The reflection, transmission, and phase change in thin Pt films deposited on glass plates is calculated on the assumption that the Pt films possess the same structure as massive Pt. The results have been experimentally verified. H. G. C.

2442. Reflection and Absorption of Visible Radiation in the System KCl–CuCl$_2$. G. Glockler and R. E. Dietmeier. *Am. Chem. Soc., J.* 60. *pp.* 753–754, *April,* 1938.—Solid anhydrous CuCl$_2$ shows a maximum of reflection at 6404 Å as do mixtures with dry KCl. The mixtures have an absorption maximum at 5387 Å which is ascribed to the trichlorocuproate ion. AUTHORS.

2443. Reflection by Crystals in Far Ultra-Violet. G. Rathenau. *Physica,* 5. *pp.* 417–426, *May,* 1938. *In German.*—U.v. light of the region 2350–1550 Å is twice reflected from crystal surfaces, the angle of incidence being 45°. In comparing the incident and the reflected light for NaNO$_3$ a pronounced decrease of reflecting power below 1850 Å is found. Calcite shows increasing reflecting power in the region of short wave-lengths. K$_4$(Fe(CN)$_6$) has a reflection minimum at about 2000 Å. Further data about diamond, gypsum and sulphur are given. No strong variation of reflecting power is found for these substances in the wave-length region under investigation. AUTHOR.

2444. Thick Lenses. F. Record. *Phil. Mag.* 25. *pp.* 801–807, *May,* 1938.—A method is described using extrafocal distances which facilitates the solution of problems involving thick lenses or combinations of thin lenses. A. H.

2445. Refractive Index and Molecular Refraction of H_2S and D_2S. O. E. Frivold, O. Hassel and E. Hetland. *Phys. Zeits.* 39. *pp.* 224–225, *March* 15, 1938.—The arrangement is similar to that formerly employed. Ice, NaCl, solid CO_2 and acetone were used as cooling agents. Measurements were carried out with wave-lengths 4046·6, 4358·3, 4916·0, 5460·8, 5893·0 and 6562·0 Å. In the case of H_2S the mean value of $(n_0 - 1) + 10^8$ for 5460·8 Å is 643·50 ± 0·02. For D_2S the mean value for the same wave- length is 640·54 ± 0·02. [See Abstracts 1643 (1936) and 2090 (1937).] J. J. S.

2446. Dispersion and Optical Anisotropy of Molecular Oxygen in Relation to its Absorption Spectrum. P. Pattabhiramayya. *Indian Acad. Sci., Proc.* 7*A. pp.* 235–244, *March*, 1938.—A new dispersion formula for gaseous oxygen has been worked out, which is simultaneously able to explain the observed optical anisotropy of O_2 and its dispersion. The characteristic frequencies found are λ 695 and λ 970 in the Hopfield absorption band region, λ 1831, λ 1903 and λ 1971 in the Schumann region and λ 2429 in the region of the Herzberg bands. The two frequencies found in the Hopfield band region are alone sufficient to explain the dispersion between λλ 5500 to 3500 and give depolarisation of scattered light of 6·68% at λ 5500 in good agreement with the observed depolarisation of 6·5% using while light. The frequencies used to explain the dispersion are all from those of actually observed absorption bands in the spectrum of O_2. In no case is it necessary to choose any frequencies from the regions of continuous absorption. The constant associated with the frequencies λ 695 and λ 970, *viz.*, 2·7798, yields a value of the number of the dispersion electrons of 3·5, while the *f*-numbers associated with λλ 695 and 970, λ 1847 and λ 2429, *viz.*, 2·7332, $2 \cdot 23 \times 10^{-2}$ and $1 \cdot 4 \times 10^{-4}$ respectively, are in consonance with the vibrator intensities which explain the relative ease with which the various absorption bands can be developed. AUTHOR.

See also Abstracts 2243, 2250, 2261, 2435, 2436.

SPECTROSCOPY.

2447. Transport of Material in Sources for Spectroscopic Analysis. G. O. Langstroth and D. R. McRae. *Canad. J. of Research,* 16. *Sect. A. pp.* 61–74, *March*, 1938.—A study of the transport of material in the condensed d-c. spark discharge has been made, with the object of placing quantitative spectroscopic methods of analysis on a less empirical basis and thus permitting, (*a*) the recognition of certain conditions of source operation which lead to unreliable determinations, and (*b*) the determination of some of the criteria to be fulfilled for maximum precision in analytic measurements. Variations in the transport phenomena, as indicated by variations in the relative distributions of emitting atoms of various elements along the discharge axis on the addition of certain substances to a sample, appear to be closely connected with the ionisation potentials and masses of the elements, and with the ionisation potentials of other particles present in the discharge. The data indicate the necessity for the use of a spectroscopic buffer, and provide certain criteria for the choice of the buffer and of the internal standard element. The exact nature of the mechanism of transport is uncertain, but various considerations indicate that neither the motion of ions under the influence of the field nor diffusion in the ordinary sense is sufficient to account for observed features. AUTHORS.

2448. Spectrum of Calcium. N. E. Wagman. *Univ. of Pittsburgh, Bull.* 34. *pp.* 325–334, *Oct.* 1, 1937.—Details are given of precise wave-length determinations by means of the interferometer of 102 Ca arc lines and of the 3 strong Ca lines in the infra-red. The observations extend from λ 2200 to λ 9000. A. H.

2449. High Terms of Paschen Series in Hydrogen and Deuterium. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 14. *pp.* 53–56, *Feb.*, 1938. *In English.*—Previous work is extended [see Abstract 3575 (1937)] and photometric curves are given of the Paschen series in H_2 and D_2 excited by an electrodeless discharge. There is considerable overlapping due to lines of impurities released from the walls of the tube, although these are counteracted as far as possible by using a continuous flow of H_2 or D_2 and by passing the discharge intermittently. D_2 peaks are doubtful beyond $m = 24$, and in the case of H_2 the photogram is hazy, and evidence of secondary lines is discussed in relation to other available data. N. M. B.

2450. Emission and Reversal in Excited Thallium Vapour. G. Kurz. *Ann. d. Physik*, 31. 6. *pp.* 473–496, *March*, 1938.—Measurements of intensity and reversal of the first member of the sharp series were made with various pressures and currents, using special light source and discharge tube. The reversal measurements indicate an exciting temperature of 2650-3800° K. and states concerned to be $6^2P_{1/2}$, $6^2P_{3/2}$ and $7^2S_{1/2}$. In view of the approximate constancy of intensity of u.v. lines, with various currents, it is concluded that the vapour is strongly ionised. F. S.

2451. Cs^+ Spectrum. R. Ricard. *Comptes Rendus*, 206. *pp.* 905–906, *March* 21, 1938.—The explanation of several of the stronger lines demands the postulation of the excitation of two electrons. Seventeen new terms are suggested. H. G. C.

2452. Near Ultra-Violet Bands of Acetylene. Sho-Chow Woo, Ta-Kong Liu, T. C. Chu and Wu Chih. *J. Chem. Phys.* 6. *pp.* 240–246, *May*, 1938.—The spectrum of C_2H_2 at room-temperature and 300°C. was taken with a Bausch and Lomb large quartz spectrograph. The spectrum extends from 2430 Å down to the u.v. limit of the instrument. More than 1000 bands and lines have been measured. Most of the bands revealed intensification at elevated temperature. Some of them have been partially resolved into rotational lines with alternating intensities. Seven main progressions all with frequency difference $\sim$ 1050 cm^{-1}. have been found. Only the bands of three of the progressions showed no intensification at higher temperature. From the differences between these bands, a frequency 580 cm^{-1} has been observed. Weaker bands on the red side of stronger ones have been proved through temperature variation to be due to transitions from the excited $2\nu_5''(E_g)$ level in the ground state. Through a tentative assignment, $2\nu_5' = 1050$ cm^{-1}. and $\nu_4'(E_u) = 580$ cm^{-1}. and the empirical selection rules, all of the bands in the seven progressions can be satisfactorily explained. Other possible assignments and the nature of the electronic transition are also briefly discussed. AUTHORS.

2453. Infra-Red Absorption Spectra of Isomeric Aliphatic Hydrocarbons. P. Lambert and J. Lecomte. *Comptes Rendus*, 206. *pp.* 1174–1176, *April* 11, 1938.—The infra-red spectra between 500 and 1450 cm^{-1}. of two isomeric pentanes and 17 octanes were determined, and the relations thereof to constitution discussed with special reference to the spectra of mixtures. [See Abstract 2527 (1934).] C. A. S.

2454. Spectrum of Tu IV. H. Gobrecht. *Ann. d. Physik,* 31. 7. *pp.* 600–608, *April,* 1938.—The absorption and emission spectra of some Tu compounds are photographed in the u.v., visible and infra-red from about 2600 Å to 11000 Å with a view to determining the mean positions of the groups of lines rather than the fine structure detail. The principal term values of the Tu IV spectrum are determined from the measurement and are found in good agreement with the term values derived independently from formula, from comparison with the spectra of La II and Pr IV and by the method of Slater, Condon and Shortley. [See Abstract 3075 (1931).] J. E. K.

2455. Screening Constants and Multiplet Transitions of the Rare Earths. H. Gobrecht. *Ann. d. Physik,* 31. 8. *pp.* 755–760, *April,* 1938.—The absorption of rare earths in the infra-red has been measured, and the absorption lines are tabulated. From these results and the data given by the fluorescence spectra the multiplet components of the ground state of the ions of rare earths are found, and the screening constant is calculated. The energy difference between the ground state and the highest multiplet level and the screening constant are given for the elements Ce, Pr, Nd, Sm, Eu, Tb, Dy, Ho, Er, Tu, Yb. The screening constant increases from 28 for Ce to 35·9 for Yb. L. K.

2456. Arc Spectrum of Indium, In I. F. Paschen. *Ann. d. Physik,* 32. 1–2. *pp.* 148–154, *May,* 1938.—Difficulties in the electronic explanation of spectra arise where there is more than one valency electron. These are discussed in connection with the spectra In I and In II. The separations $n^2D_{3/2} - n^2D_{5/2}$ of the first five ^2D terms of In I are anomalous, and this is also the case for Al I and Ga I. The separation is smaller for the lowest ^2D terms than for succeeding terms. In In II, Ga II, and Al II the lowest $nsnd\,^1D_2$ term has a considerably larger numerical value than the lowest $nsnd\,^3D_2$ term. These irregularities are discussed. Tables of term values and wave-lengths of lines in the spectrum of In I are given. A. J. M.

2457. Measurements of the Forbidden P-P Series of Li I in the Carbon Arc. R. Siksna. *K. Acad. Amsterdam, Proc.* 41. 3. *pp.* 253–263, 1938. *In German.*—With a view to obtaining information concerning the electric field in the column of an arc discharge the behaviour of some "forbidden" Li lines in the arc is investigated. These lines are the 3P-2P, 4P-2P and 5P-2P lines at λλ6240, 4636 and 4147 Å respectively, they are found to exhibit no perceptible wave-length displacement in the arc. The lines are all asymmetrical, the higher series members having the greater asymmetry. For temperatures from 4400° to 5200° Abs. the 3P-2P and 4P-2P lines are of about equal intensity but the intensity of 5P-2P shows a considerable relative increase; all three lines become narrower with increasing temperature. J. E. K.

2458. Width of Spectral Lines in High Pressure Hg Discharge. R. Rompe and P. Schulz. *Zeits. f. Physik,* 108. 9–10. *pp.* 654–667, 1938.—With the aid of a concave grating, the width of a number of lines in a high pressure Hg discharge lamp is measured photometrically in the region 2967-10140 Å. The 2^1P_1 term is symmetrical and of great width whilst that of the $^1S_0$ state is negligibly small. Electron bombardment causes symmetrical broadening in the 3^1D_2 and 3^3D_2 terms whilst the asymmetrical broadening of the lines of the triplet system is probably due to statistical effects. [See Abstract 680 (1936).] H. J. H. S.

2459. Intensity Measurements in Hyperfine Structure of the Mercury Line $6^3P_2 - 7^3S_1$, 5461A in Absorption. H. C. Burger and P. H. van Cittert. *Physica,* 5. *p.* 464, *May,* 1938. *In English.*—A correction. [See Abstract 1643 (1938).]

2460. $3d^84s$ Configuration of NiII. T. Yamanouchi. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 242–244, *March,* 1938.—The configuration is very near to LS coupling, but ^4P terms are partly inverted, and the interval of two ^2D terms, which should be zero according to the L.S. formula, is even larger than that of ^2P. This suggests strong perturbation between ^4P and ^2D. Using the method of second order perturbations [see Abstract 2102 (1937)], these effects are considered quantitatively, and it is shown that the electrostatic energies of the two terms are very close together. The anomalies of intervals and *g*-values are then satisfactorily accounted for. N. M. B.

2461. Polarisation of Light Emitted from Canal Rays. H. Angenetter and H. Verleger. *Phys. Zeits.* 39. *pp.* 328–332, *April* 15, 1938. *From the Reichsanstalt.*—The polarisation of the light emitted by Li, Na, Ne, A and Hg in canal rays is measured. The magnitude of the polarisation of a given line is shown to depend on the corresponding initial and final electronic states. Values of $I_\parallel/I_\perp$ less than unity actually occur. C. B. A.

2462. Application of the Infra-Red Absorption Spectra to the Determination of the Position of Ethylene-Linkages. P. Lambert and J. Lecomte. *Comptes Rendus,* 206. *pp.* 1007–1009, *March* 28, 1938.—The authors show that it is possible to locate the $C = C$ bond in an aliphatic compound by studying the spectral region 850 to 1000 cm^{-1}. [see Abstract 4290 (1935)]. In ramified aliphatic hydrocarbons two strong bands are found at 850 and 890 cm^{-1}., whose positions do not vary with the length of the chain, and which do not occur in saturated compounds. In non-ramified hydrocarbons the bands are displaced to 910-920 and 980–990 cm^{-1}., if the $C = C$ linkage is at the end of the chain, and to 910–920 and 950–960 cm^{-1}., if they are not. The same results apply to compounds of the form $R - CH = CH - CH_2 - Br$, $R - CH = CH - CH_2 - CN$, $R - CHOH - CH = CH_2$. These bands are not caused by the valence vibrations of the $C = C$ linkage (1600–1650 cm^{-1}.), but are due to vibrations of the whole chain which explains their sensitivity to the ramification of the chain. Confirmation of this view is given by the fact, that in cyclic compounds like cyclopentene, this spectral region has a completely different aspect. L. K.

2463. Infra-Red and Raman Spectra of Cis- and Trans-Butene-2. H. Gershinowitz and E. B. Wilson, Jr. *J. Chem. Phys.* 6. *pp.* 247–251, *May,* 1938.—The infra-red absorption spectra of gaseous cis- and trans-butene-2 have been measured with a prism spectrometer [see Abstract 2052 (1938)]from 435 to 4000 cm^{-1}. The Raman spectra of these compounds as liquids have also been obtained. The accepted identification of the high boiling isomer with the *cis* structure is confirmed by the fact that this compound shows many more coincidences between the Raman and infra-red spectra than the other isomer, as is to be expected if the latter approximates a molecule with a centre of symmetry. The observed frequencies below 800 cm^{-1}. are sufficiently different for the two isomers so that it is not safe to assume that both isomers have the same vibrational entropy. AUTHORS.

2464. Absorption Spectra of Copper, Cobalt and Nickel Sulphates in Heavy Water. A. A. Zanko and A. E. Brodsky. *Acta Physicochimica,* 8. 3. *pp.* 309–314, 1938. *In English.*—Absorption curves of $CuSO_4$, $CoSO_4$, $CoCl_2$ and $NiSO_4$ in D_2O and H_2O have been measured. The absorption maxima are not shifted when H_2O is replaced by D_2O, but in the latter case the absorption bands undergo a symmetrical compression. AUTHORS.

2465. Base Strengths and Absorption Spectra of *p*-Methyl- and *p*-Bromo-acetophenone. L. A. Flexser and L. P. Hammett. *Am. Chem. Soc., J.* 60. *pp.* 885–886, *April,* 1938.—The u.v. absorption of solutions of *p*-methylacetophenone and of *p*-bromoacetophenone in various mixtures of H_2SO_4 and water has been measured and values of the base strengths of these ketones derived therefrom. The effect of substituents upon the free energy of the basic ionisation of acetophenone is of the order of $-2\cdot56$ times the effect upon the acid ionisation of benzoic acid. AUTHORS.

2466. Optical Investigations of the Adsorption of Porphyrins. F. Bandow. *Zeits. f. phys. Chem.* 39. *Abt.B.* 3–4. *pp.* 155–193, 1938.—Continuing previous work [see Abstract 238 (1937)] photometer curves of the fluorescence spectra of adsorbed and dissolved porphyrins are studied. Additional adsorbers (talcum, silica gel and the oxide and hydroxide of Be) are investigated. The quantum yield for the fluorescence excitation of porphyrin solutions is less than unity ; for adsorbed porphyrin, especially when damp, the value is higher than for solution. Photometric measurements of fluorescence are employed to investigate the distribution of certain porphyrins between solution and various adsorbing materials, and extremely large differences are observed. L. A. W.

2467. Distribution of Rotational States in the Elementary Process of Molecule Formation and the Variation of the Relative Probability of Transition. H. Schüler and H. Gollnow. *Zeits. f. Physik,* 108. 11–12. *pp.* 714–725, 1938.—The variation of intensity of the lines of the CuH band at 4280 Å has been investigated for excitation in the arc, and with a discharge tube with a hollow kathode cooled by water, and by liquid air. In the band excited by the arc the rotational states are distributed among the molecules according to the Boltzmann law, but with the hollow kathode another distribution was found corresponding to that of molecules in the various rotational states in the elementary process of molecule formation. There is also a difference in the probability of transition in the two cases of excitation. The intensity of lines arising from a common initial state does not follow the formula of Hönl and London in the cases of excitation with the hollow kathode. **Erratum,** *ibid.* 109. 5–6. *p.* 432, 1938. A. J. M.

2468. Potential Function of $C_2H_xD_y (x + y = 4)$. Yong-Li Tchang. *Ann. Soc. Sci. de Bruxelles,* 58. *pp.* 89–97, *March* 19, 1938.—The potential function of the molecule has been calculated [see Abstract 2643 (1937)]. The agreement with observed values is better than $1\cdot4\%$. In calculating the anharmonicity of the vibrations, the masses $H = 1\cdot088$ and $D = 2\cdot126$ are used. The usual values give poor agreement. H. G. C.

2469. Universal Constant of Band Spectra. H. Deslandres. *Comptes Rendus,* 206. *pp.* 1153–1157, *April* 11, 1938.—The method of a previous paper [see Abstract 1211 (1938)] is applied to a further series of spectra. H. G. C.

2470. Fluorescence and Absorption Spectra of Pr^{+++} and Eu^{+++}. Part I. Energy States of Pr^{+++}. H. Lange. *Ann. d. Physik,* **31.** 7. *pp.* 609–618, *April,* 1938.—The emission and absorption of the rare-earth ions have been explained as due to transitions in the $4f$ shell. Gobrecht has given the outlines of an analysis of the spectra [see Abstract 221 (1937)]. This paper represents an attempt to investigate the theory of these spectra and to evaluate the terms for Pr^{+++} which, with its $4f^2$ configuration and 7 possible terms — ^{1}(SDGI) ^{3}(PFH) —, is the simplest rare-earth ion next to Ce^{+++} (one term). The formulæ given by Slater from a wave-mechanical perturbation method [see Abstract 418 (1929)] are adapted to get the term energies. The results confirm the analysis of Gobrecht and suggest term values for the isoelectronic elements BaI and Ce III. J. E.

2471. Optical and Photochemical Study of the Vapours of Cuprous Halides. J. Terrien. *Ann. de Physique,* **9.** *pp.* 477–538, *April,* 1938.—The polymerised vapours of Cu_2Cl_2, Cu_2Br_2 and Cu_2I_2 exhibit continuous absorption from the Schumann region into the nearer ultraviolet. In the case of Cu_2Cl_2 there is a relative maximum at about 2230 Å. The fluorescence shows that the absorption in this region produces dissociation into 2CuCl, one of which is excited and emits characteristic fluorescence bands. The fluorescence spectrum also contains the Cu doublet, $\lambda = 3247$–3274, due to the expulsion, followed by an optical resonance, of Cu atoms from the Cu_2X_2 molecule. The velocity of these atoms at the moment of photodissociation is determined by exciting their resonance by means of lines with a measured variable reversal. The wave-length limit for each mode of dissociation is determined, and the dissociation energy agrees with that derived thermochemically if account is taken, in the second case, of the kinetic energy deduced from the resonance experiments. Analogous resonance effects with copper are observed and explained. The band spectrum of CuCl is now photographed at high intensity and dispersion, and the rotational structure of several bands is studied. The bands of the four isotopic molecules of CuCl are distinguished, and the natures of the fundamental level $(X = {}^1\Sigma)$ and two excited levels $(D = {}^1\Pi : E = {}^1\Sigma)$ are identified. C. B. A.

2472. Effect of Temperature on the Raman Spectrum of Liquid CCl_4. R. Ananthakrishnan. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 196–207, *March,* 1938.—After a brief review of Placzek's theory of the Raman effect, the paper gives a short account of the experimental investigations that have been hitherto carried out to verify the intensity relationships predicted by the theory. The latter indicates that (*i*) the ratio of the intensities of the Stokes and the anti-Stokes components tend to approach more and more towards unity with increasing temperatures, and (*ii*) that the absolute intensities of both the Stokes and the anti-Stokes lines increases with increasing temperature. While theory and experiment have been found to be in conformity as regards (*i*), considerable discrepancies have been noticed in respect of (*ii*). In the case of crystalline solids like quartz, calcite, etc., previous work shows that the Stokes lines, instead of showing the expected rise in intensity, exhibit a pronounced weakening at higher temperatures. In this connection, the Raman spectrum of liquid CCl_4 has been investigated over an interval of temperature extending from 25° to 200° C. and the spectral changes noticed are discussed. The degenerate vibrations manifest considerable broadening at higher temperatures, the doublet at (762–790) cm^{-1}., well resolved at the lower temperature, appearing as a single broad and diffuse band in the spectrum photographed at 200° C. The totally symmetric vibrational Raman line at 459 cm^{1}. is also somewhat more diffuse at the higher temperatures and shows a small diminution in frequency. The integrated intensities of the Stokes lines of CCl_4 seem to show no increase at the higher temperature. It is suggested that the effect of anharmonicity of the nuclear vibrations and the centrifugal stretching of the molecule due to rotation, is probably responsible for this departure from the expected increase in intensity. AUTHOR.

2473. Effect of Oblique Refraction at the Prism Surfaces on the Relative Intensities of Raman Lines. A. V. Rao. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 208–213, *March*, 1938.—The effect of the polarisation introduced by oblique refraction at the prism faces in a spectrograph on the relative intensities of Raman lines is discussed. It is shown that if illumination from the side is adopted, the intensity of the well-polarised lines is apparently diminished in relation to the unpolarised ones and the reverse if illumination from the top is adopted. A particularly striking illustration is provided in the Raman spectrum of CCl_4. AUTHOR.

2474. Raman Effect in Sodium Nitrate. P. Pattabhiramayya. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 229–234, *March*, 1938.—The Raman spectrum of a large single crystal of $NaNO_3$ is obtained at room-temperature and at about 280° C. The frequency of the principal line at the high temperature is found to be about 3 to 4 wave-numbers smaller than that at room-temperature. Of the two lattice oscillations 185 and 95, the former is more intense at room-temperature, whereas the latter is more intense at the high temperature. The results obtained by the earlier workers in respect of solutions are confirmed. It is further reported that with increasing dilution, the frequency 730 gains considerably in intensity when compared with the frequency 1400. In this respect the nitrate ion solution resembles the carbonate ion in the solid state. AUTHOR.

2475. Raman Spectrum and Constitution of Pentaerythritol. P. G. N. Nayar. *Indian Acad. Soc., Proc.* 7*A*. *pp.* 251–255, *March*, 1938. The Raman spectrum of pentaerythritol is studied in the solid state and 21 frequencies observed. The molecule is shown to possess tetrahedral symmetry in agreement with recent X-ray studies, and the frequencies are discussed with reference to the " neopentyl group " and the frequencies in other aliphatic alcohols. The O–H frequency is found to be characteristic of the presence in the crystal of the linking of molecules by the "H bond." AUTHOR.

2476. Raman Spectra of Crystalline Powders. E. Canals and P. Peyrot. *Comptes Rendus*, 206. *pp.* 1179–1181, *April* 11, 1938.—The Raman spectra of naphthalene, oxalic, tartaric and citric acids, NH_4, Na and K tartrates, urotropine, antipyrine, and pyramidon are recorded and discussed. W. R. A.

***2477. Automatic Photography of the Raman Spectra of Liquid Mixtures and Application of the Method to the Quantitative Determination of the Constituents. A. Andant.** *Comptes Rendus*, 206. *pp.* 1294–1296, *May* 2, 1938.—Apparatus suitable for measuring Raman spectra automatically is described and the limits of accuracy are discussed. W. R. A.

***2478. Constant Deviation Monochromator for Visible and Ultra-Violet. R. Fortrat.** *Rev. d'Optique*, 16. *pp.* 386–392, *Nov.*, 1937.—The essential optical parts consist of a Féry prism and two fixed slits, rotation of the prism being the only necessary adjustment. It can be transformed into a direct-vision instrument by the addition of two mirrors cut from the same block of glass as the prism and actuated by the same movement. F. S.

***2479. Vacuum Spectrograph. B. K. Johnson.** *Journ. Sci. Instruments*, 15. *pp.* 126–128, *April*, 1938.—To assist in the investigation of the transparency of materials suitable for use in u.v. microscopy, a simple prismatic vacuum spectrograph has been devised. The optical system is of fluorite or, alternatively, of LiF, and both camera and collimator lenses are (at 1600 Å) of 6·0 cm. focal length and of 12·5 mm. dia., thus giving an aperture ratio of *f*/4·8. For various reasons the spectrograph has been made as small as possible and it is contained in a vertical cylinder 8" long and 3" in dia. Exposures as short as 3 sec. give good spectrograms and 5 min. is sufficient for all the operations necessary to obtain a spectrogram. No lines below 1300 Å have so far been recorded. A. H.

***2480. Two Spectrographic Irradiators for the Visible and Ultra-Violet Regions. M. O. Pelton.** *Journ. Sci. Instruments*, 15. *pp.* 159–163, *May*, 1938.—Details are given of two large spectrographs, constructed from inexpensive components, and suitable for irradiating materials with monochromatic light. High spectral intensity and low cost have been aimed at, the purity of the spectrum being of minor importance. AUTHOR.

2481. Excitation of Light in Atomic Collisions between He or H and Alkaline Earths. K. Gailer. *Zeits. f. Physik*, 108. 9–10. *pp.* 580–591, 1938.—In collisions between H or He canal rays with atoms of Be, Mg, Ca, Sr or Ba only the lines of the alkaline earth are excited, although the relative kinetic energy of the colliding atoms exceeds the excitation potential of H and He. R. P.

2482. Emission of Light by Low Velocity Particles. A. Kotecki. *Zeits. f. Physik*, 108. 9–10. *pp.* 640–653, 1938.—The excitation function is measured for collisions between H_2 particles and H_2, Hg, A and He and between A and H_2 and Hg. A low-voltage capillary discharge is used as a source of ions and the excitation phenomena which occur in the region 1-6 kV are studied. The results are in agreement with the hypothesis of Döpel [see Abstract 1629 (1933)] except in the case of collisions between H_2 and He. H. J. H. S.

See also Abstracts 2337, 2372, 2416, 2417, 2446, 2494, 2495.

TRANSMISSION.

See Abstracts 2441, 2479.

VISION.

2483. Photochemical Basis of Vision. S. Hecht. *J. of Applied Physics*, 9. *pp.* 156–164, *March*, 1938.—Reviews the history of the discovery and investigation of visual purple and illustrates how photochemical concepts may be applied to explain some of the facts of vision. W. S. S.

2484. Duplexity Theory of Visual Response in Vertebrates. W. J. Crozier, E. Wolf and G. Zerrahn-Wolf. *Nat. Acad. Sci., Proc.* 24. *pp.* 125–130, *March*, 1938.—Experiments with diurnal turtles yielded the relation between the critical brightness of a flickering light to which the animal would just respond and the flicker frequency. The relation fails to show the characteristic change of law at a certain brightness which is associated with a transition from rod to cone vision. The curve obtained is simple and of the type attributable to the cones. Since the diurnal turtle has a rod-free retina, the result provides additional evidence for the duplexity theory. W. S. S.

2485. Minimal Discrimination of Intensities. Part III. W. J. Crozier and A. H. Holway. *Nat. Acad. Sci., Proc.* 24. *pp.* 130–135, *March*, 1938.—Offers further data on the scatter of experimental measurements of smallest perceptible brightness differences showing that the variations are due in the main to variations of the " reactive capacity of the organism " and not to faulty experimental arrangements. [For Part II see Abstract 5368 (1937).] W. S. S.

2486. Sedimentation Constant of Visual Purple. S. Hecht and E. G. Pickels. *Nat. Acad. Sci., Proc.* 24. *pp.* 172–176, *April*, 1938.—Determinations of the rate of sedimentation of solutions of visual purple gave results similar to those found for proteins such as edestin, excelsin and phycoerythrin. The molecular weight of visual purple is estimated to be about 270,000 and it is suggested that the molecule has a nearly spherical form. Bleached solutions of visual purple gave about the same sedimentation rate, showing that bleaching does not result in any drastic splitting of the molecule. W. S. S.

2487. Structure of the Retina and the Rôle of Visual Purple. R. J. Lythgoe. *Phys. Soc., Proc.* 50. *pp.* 321–339, *May* 2, 1938.—Present knowledge of retinal structure and, in particular, of the form, distribution and number of the rods and cones and their nervous connections, is outlined. The properties of visual purple and the products of its decomposition by light are discussed. It is then shown how far these physiological data yield explanations of the phenomena of vision. W. S. S.

X-RAYS.

2488. Heating of a Crystal by the Kossel Effect. M. v. Laue. *Phys. Zeits.* 39. *pp.* 339–343, *April* 15, 1938.—The question of the heating of the antikathode is of fundamental importance in the construction of an X-ray tube ; it has been treated theoretically by Müller [see Abstract 1075 (1930)]. A mathematically rigid calculation is given of the stationary temperature distribution in a cylindrical antikathode, from a consideration of the depth of penetration of the electrons. It is supposed that the electrons only strike a small part of the antikathode. Then the rise in temperature and the temperature distribution in the focal spot is essentially the same as if the antikathode filled half the space. The results depend only little on the form of the antikathode crystal, and may be used for other forms without great alterations, provided that there is always efficient cooling. In order to make full use of the equations more data are required about the production of heat in matter by kathode rays. C. J. B. C.

***2489. Use of Intensifying Screens in X-Ray Diffraction Work. C. Gamertsfelder and N. S. Gingrich.** *Rev. Sci. Instruments*, 9. *pp.* 154–159, *May*, 1938.—In an attempt to reduce exposure times for monochromatic X-ray diffraction patterns of liquids, a Fluorazure intensifying screen has been used, and several tests of the applicability of this method to intensity measurements have been made. The intensifying factor for Mo Kα radiation varied from 1, for very low intensities or very short exposures, to 13·3 for intermediate intensities, and for Cu Kα radiation it varied from 1 to 4. It appears impractical to use this screen when true intensity measurements are necessary. However, by using two ordinary X-ray films in contact, the exposure time, with Mo radiation, may be reduced to nearly one-half, and true intensity measurements may be made. With a new type of double emulsion film, true intensities are recorded and exposure times are reduced by a factor of 2·5 for Mo radiation. AUTHORS.

2490. X-Ray Detection of Lattice Distortion and Determination of Particle Size. R. Fricke. *Zeits. f. Elektrochem.* 44. *pp.* 291–295, *May*, 1938.—A connected account with many references of the influence on the breadth of the lines and integral intensity of X-ray interference as appearing in Debye-Scherrer photographs, on the assumption that these are due to primary small particles ≯ 10000 Å; of the size of the small particles; irregular slipping of layers in layer lattices; domains with various lattice constants; lattice disturbances with one or several periods caused by the greater or less tendency of atoms or a group thereof to revert to their true position of rest; admixture of amorphous material and methods for determining the amounts of such material; suggestions for obtaining useful photographs. C. A. S.

2491. X-Ray Measurement of Particle Size. F. W. Jones. *Roy. Soc., Proc.* 166*A*. *pp.* 16–43, *May* 4, 1938.—The constant C of the formula $\beta_\chi = C\lambda/t \cos \frac{1}{2}\chi$ of Scherrer, Bragg and Seljakow is considered theoretically and shown to be approximately equal to unity. A new experimental method for the determination of the broadening of powder photograph lines due to experimental conditions and the inhomogeneity of the radiation is described. This method is based on comparing the lines obtained from a standard substance with those from the experimental material. The experimental carrying out of this method is also described, as well as the results obtained from colloidal gold. The question of particle shape is also discussed, much along the lines of the work of Brill, but with the simplification introduced by the use of "shape curves." The observed mean size of the particles will differ from the true mean size by an amount depending on the exact form of size distribution. Various assumptions about size distributions are discussed. G. G.

2492. L Spectrum of Fe. J. Farineau. *Comptes Rendus*, 206. *pp.* 1011–1012, *March* 28, 1938.—The lines L_α and L_β of Fe have been photographed with the help of a vacuum spectrograph and a curved crystal. L_α lies between the limits 17·51 and 27·64 Å; the maximum of L_β is at 17·18 Å. Both lines have a magnitude of 5·5 eV. The curve of the intensity of the lines as function of the wave-length ends tangentially on the λ-axis. If the number n of the electrons which are on the average in the state N_I per atom, is calculated from the magnitude E_m of the emission band, it is found to be 0·6 electron N_I per atom, while 0·22 follows from ferromagnetic data. This discrepancy is attributed to the Auger effect which broadens the lines. A calculation which takes the Auger effect into account, shows that it may result in a broadening of the lines of the order of 2–3 eV, *i.e.* 50%. L. K.

2493. X-Ray-Spectroscopic Quantitative Analysis of Nb, Y and Sr in Zirconium Minerals. M. Blokhin. *Techn. Phys., U.S.S.R.* 5. 2. *pp.* 147–152, 1938. *In English.*—The study was carried out by the method of comparison on the spectrograph by the Cauchois method, taking into account the various factors, which might affect the results. A comparison of the results with those obtained by chemical analysis shows good agreement. AUTHOR.

See also Abstract 2546.

HEAT.

CALORIMETRY.

2494. Molecular Heat of Organic Vapours. K. Bennewitz and W. Rossner. *Zeits. f. phys. Chem.* 39. *Abt.B.* 2. *pp.* 126–144, 1938.—A method for determining the molecular heat, C_p, of organic vapours based on that of Scheel and Heuse is described. The molecular heat and the heat of vaporisation of about 20 substances containing C, H, and O only have been determined. An empirical formula for the calculation of the molecular heat at a given temperature by the addition of values for the different atoms and linkings present in the molecule is derived. A semi-theoretical formula, based on the deformation and valency vibrations of the molecule obtained from the Raman spectrum, which enables the molecular heat to be calculated in a simple manner from the formula of the compound is advanced, and tested for a number of substances. The results agree well with experiment. A. J. M.

2495. Specific Heats of Liquids in Relation to Raman Effect Data. S. Bhagavantam. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 245–250, *March*, 1938.—The specific heats of liquid benzene, CCl_4 and CS_2 are calculated with the help of the known fundamental frequencies in each case at different temperatures. Two alternative methods of evaluating the contribution to specific heat of translational and rotational degrees of freedom are adopted. In the first, a Debye function is assumed as in the case of a solid, and in the second, a mean energy of KT/2 per degree of freedom per molecule is assigned as in the case of a gas. The observed specific heats are found to lie between these two extremes. It is therefore concluded that in liquids thermal movements of molecules are partly in an organised manner constituting Debye elastic waves as in a solid and partly in a random manner as in a gas. Analogy is drawn between this conclusion and the results obtained in light-scattering in respect of the fine structure of the Rayleigh line in liquids where two displaced Brillouin components and one undisplaced central component are usually observed. AUTHOR.

2496. Specific Heats of Zirconium Nitride and Magnesium Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers*, *No.* 774. *pp.* 399–405, *April*, 1938. *In English.*—The mean specific heat of zirconium nitride was measured by the ice calorimeter over three temperature intervals: 0° C.∼99·7° C., 0° C.∼305·3° C., 0° C.∼500·3° C. and the equation of the true specific heat within the limit over the above temperature intervals is obtained: $C = 0{\cdot}0946 + 9{\cdot}242 \times 10^{-5}t - 9{\cdot}75 \times 10^{-9}t^2$. The mean specific heat of magnesium nitride was also determined by the same method over three temperature intervals: 0° C.∼99·6° C., 0° C.∼322·6° C., 0° C.∼418·2° C. and the equation of the true specific heat within the limit over the above temperature ranges is obtained: $C = 0{\cdot}2260 + 2{\cdot}462 \times 10^{-4}t - 3{\cdot}693 \times 10^{-8}t^2$. AUTHOR.

2497. Specific Heat of Pure Fe. A. J. Zuithoff. *K. Akad. Amsterdam, Proc.* 41. 3. *pp.* 264–274, 1938.—Results of a detailed determination of the specific heat of pure electrolytic Fe between 25° and 1500° C. are given. The measurements were made in platinum vacuum crucibles. The conclusion is drawn that irregularities in the behaviour of α-Fe between 100° and 760° C. are caused by and intimately connected with the presence and final expulsion of gases (probably H_2) dissolved in the metal. An empirical formula is given for the specific heat and also for the atomic heat between 25° and 600° C. The C_p-t curve for α-Fe shows a permanent discontinuity between 130° and 190° C. not attributable to the presence of H_2 in the metal. This is in agreement with the results of other workers. It is also stated that Dulong and Petit's law does not hold at all for Fe at temperatures as low as 100° C. R. L.

2498. Heat Produced by the Internal Deformation of a Block of Lead Influenced by its Own Weight. W. Świętosławski, L. Keffler and J. Salcewicz. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10*A*. *pp.* 546–554, *Nov.–Dec.*, 1937. *In English.*—The method of Świętoslawski and Salcewicz for measuring very small heat effects, produced in prolonged processes, was applied to the qualitative as well as to the quantitative investigation of the thermal phenomena taking place inside a solid block of lead suspended from wires attached by means of screws to its upper surface. It was found that over a long period of time the block produced small heat effects, probably caused by some internal deformation under the action of its own weight. Such a deformation was proved directly as the result of the change in the shape of the cavities containing the thermocouples. The heat effect decreases with time changing from $0 \cdot 40 \times 10^{-4}$ on the first day to $0 \cdot 20 \times 10^{-4}$ cal./gm. per hour on the twenty-first day. The heat effects due to the internal deformation of lead may influence markedly the results of calorimetric measurements in radiology. When, therefore, large metallic blocks are used, it is necessary to control whether they do not by themselves evolve any heat. For this reason the metallic mass should be placed on a steel base and not be suspended directly by means of the upper surface. AUTHORS.

CONDUCTION.

2499. Thermal Conductivity of Gases. P. Guareschi. *Accad. Lincei, Atti,* 27. *pp.* 92–101, *Feb.* 6, 1938.—Starting from the classical kinetic theory equation connecting the thermal conductivity, viscosity and specific molecular heat at constant volume, the author introduces new expressions for the viscosity and specific heat, which gives the thermal conductivity in terms of molecular constants. One of these constants is the molecular quantum of action, $H = 1 \cdot 23 \times 10^{-23}$ erg. sec. An equation is also derived for the temperature variation of thermal conductivity. The theoretical and observed data are compared. C. J. B. C.

2500. Relative Thermal Conductivity of Metals. P. Vernotte. *Comptes Rendus,* 206. *pp.* 996–998, *March* 28, 1938.—A method is described of overcoming the difficulty of measuring the temperature at different points of the metal, without altering the propagation of heat, by means of windings of Cu wire round the metal in the form of a bar. One half of the winding acts as an electric furnace and the other half as a resistance thermometer. The mathematical theory is examined by which the relative conductivity can be deduced. N. M. B.

2501. Thermal and Electrical Resistance of a Tungsten Single-Crystal at Low Temperatures and in Magnetic Fields. W. J. de Haas and J. de Nobel. *K. Onnes Lab., Leiden, Comm. No.* 251 *d. Physica,* 5. *pp.* 449–463, *May,* 1938. *In English.*—The thermal and electrical conductivity of a tungsten single-crystal have been determined in high magnetic fields at low temperatures. For the electrical conductivity and thermal conductivity caused by the electrons the Wiedemann-Franz law holds in magnetic fields. The results prove that the separation of heat conductivity by the lattice and by the electrons will probably be possible by using still higher magnetic fields. [See also Abstract 4104 (1937).] AUTHORS.

2502. Heat Insulating Materials. E. Griffiths. *Journ. Sci. Instruments,* 15. *pp.* 117–121, *April,* 1938.—A summary of heat insulating materials suitable for various purposes such as cold storage and refrigeration work, light weight concretes, building construction, multiple partitions pipe coverings and furnaces is given, together with certain of their physical properties. A Bibliography is appended. R. L.

See also Abstracts 2503, 2507, 2615, 2616.

CONVECTION.

See Abstract 2522.

DILATATION.

2503. Thermal Expansion and Conductivity in Liquid HeII. H. Jones. *Cambridge Phil. Soc., Proc.* 34. *pp.* 253–261, *April,* 1938. The negative coefficient of thermal expansion of HeII* is shown to be a consequence of the disordering process which takes place as the temperature rises. The conclusion is reached that the thermal energy of HeII is mainly energy of disorder; the vibrational energy of the sound waves amounts only to a few per cent of the whole energy. A theory of heat conduction considered as a flow of disorder is put forward and is shown to be not incompatible with the experimental data at present available. AUTHOR.

FUSION AND SOLIDIFICATION.

2504. Freezing Point Curves of Dicetyl in Hydrocarbons. W. F. Seyer. *Am. Chem. Soc., J.* 60. *pp.* 827–830, *April,* 1938.—The freezing point curves of four paraffin hydrocarbons with dicetyl are studied, hexane, octane, decane and dodecane, also those of dicetyl-benzene and dicetyl-cyclohexane. After a concentration of about 0·4 *N* is reached the solute appears to exert its influence in determining the shape of the freezing point curve and it is suggested this may be due to the separation of mixed crystals from the solution. The experimental evidence supports the validity of Raoult's law. [See Abstract 5591 (1936).] AUTHOR.

See also Abstract 2506.

TEMPERATURE.

2505. Transition Temperature of Na_2SO_4, $7H_2O$. E. R. Washburn and W. J. Clem. *Am. Chem. Soc., J.* 60. *pp.* 754–757, *April,* 1938. A method is described for preparing Na_2SO_4, $7H_2O$ and for maintaining its transition temperature. This temperature is found to be 23·465 ± 0·004°. Because the salt is purified easily and the transition temperature is near the most used part of the thermometer scale, this point is proposed as a useful secondary standard in calibrating thermometers along with the Na_2SO_4, $10H_2O$ transition point. AUTHORS.

2506. Ice-Point as Standard of Reference. E. E. Roper. *Am. Chem. Soc., J.* 60. *pp.* 866–869, *April,* 1938.—It is shown that by an adoption of White's washing technique [see Abstract 1219 (1934)] crushed ice in a simple Dewar tube can be made to establish and maintain with certainty, a temperature of 0·000° with an accuracy of ± 0·001°, and that this can be reproduced in other ice-baths prepared by the same method. AUTHOR.

2507. Thermal Equilibrium at Temperatures Below 1° Abs. E. S. Shire and J. F. Allen. *Cambridge Phil. Soc., Proc.* 34. *pp.* 301–307, *April*, 1938.—By measuring the resistance of a phosphor bronze wire in thermal equilibrium via various substances with crystals of iron ammonium alum it is shown that the time for thermal equilibrium between the ionic magnets of the salt and its lattice vibrations is less than 0·5 sec. for all temperatures above 0·025° T. When liquid He or a german silver tube forms part of the cooled portion of the apparatus, the time for equilibrium is increased to a few seconds for temperatures below 0·4° K. It appears possible that the thermal conductivity of german silver is less than 10^{-8} cal. cm^{-1}. sec^{-1}. $degree^{-1}$ below 0·05° T, and there are indications that the thermal conductivity of liquid He at temperatures below 0·3° K. is small compared with its value at 2° K. AUTHORS.

THERMOCHEMISTRY.

2508. Heat of Combustion of Isoprene. R. S. Jessup. *Bureau of Standards, J. of Research*, 20. *pp.* 589–597, *May*, 1938.—The heat of combustion of isoprene has been measured by means of a bomb calorimeter which was calibrated with benzoic acid. The mass of isoprene burned in each experiment was determined from the mass of CO_2 formed in combustion. As the result of seven measurements the value 3156·9 ± 1·6 international kj./mol. was obtained for the heat of combustion of liquid isoprene at 25° C. and under a constant pressure of 1 atm. the products of combustion being liquid water and gaseous CO_2. Using the value 25·9 international kj./mol. calculated by Bekkedahl, Wood, and Wojciechowski for the heat of vaporisation of isoprene, the heat of combustion of gaseous isoprene is calculated to be 3182·8 ± 1·7 international kj./mol. at 25° C. and under a constant pressure of 1 atm., the products of combustion being liquid water and gaseous CO_2. Combining the data on isoprene with data reported previously on the heat of combustion of rubber hydrocarbon, there are obtained for the heats evolved in the reactions : xC_5H_8(liquid isoprene) = $(C_5H_8)_x$(rubber hydrocarbon) and $x(C_5H_8$(gaseous isoprene) = $(C_5H_8)_x$ (rubber hydrocarbon) at 25° C. and a constant pressure of 1 atm., the values $(74·8 \pm 6·2)x$ and $(100·7 \pm 6·3)x$ international kj./mol. respectively. AUTHOR.

2509. Oxidation of Carbon. S. E. Khaikina. *Acta Physicochimica*, 8. 3. *pp.* 343–356, 1938. *In English.*—The reaction of oxidation of C takes place in the whole volume of a particle (*i.e.*, the reaction proceeds not only at the outer surface, but inside the whole mass). The specific oxidation rate increases with temperature according to Arrhenius' law $K = K_0 e^{-E/RT}$. The activation energy of the electrode carbon oxidation equals 40000 cal./mol. at O_2 concentrations higher than 10%. For charcoal it is equal to 30000 cal./mol. The specific oxidation rate is independent of the linear rate of gas flow within the limits of 5–30 cm. sec., the oxidation rate being thus determined by the chemical reaction rate. At high O_2 concentrations, the reaction is almost of zero order in relation to O_2, and approaches the first order in the case of low concentrations of the latter. AUTHOR.

2510. Heats of Sublimation. K. L. Wolf and H. Weghofer. *Zeits. f. phys. Chem.* 39. *Abt.B.* 3–4. *pp.* 194–208, 1938.—Heats of sublimation are determined for a large number of organic compounds by measuring the variation of vapour pressure with temperature. In the light of the material obtained the question is discussed as to whether the

heats of sublimation of homologues show increments characteristic of groups in the molecule. Deviations from regularity in this respect are related to differences of arrangement of the molecules in the crystal.
L. A. W.

See also Abstracts 2210, 2212, 2232, 2233, 2554.

THERMODYNAMICS.

2511. Relativistic Study of the Joule-Thomson Effect in a Gas. Part I. D. V. Gogate. *Phil. Mag.* 25. *pp.* 694–702, *April*, 1938.—The Joule-Thomson effect and adiabatic changes in a gas obeying the Fermi-Dirac statistics have already been studied for the non-relativistic case, and it was shown that during a Joule-Thomson expansion a degenerate gas is *heated*, and that the amount of heating per unit fall in pressure increases with the degree of degeneracy. Further, in an adiabatic process the degree of degeneracy remains constant (Kothari). Calculations on a relativistic basis are now given for a Fermi-Dirac non-degenerate gas. The pressure and internal energy are derived and it is shown that such a gas will always be heated during a Joule-Thomson expansion. Also, a non-degenerate gas remains non-degenerate in an adiabatic change. C. J. B. C.

2512. Theory of Condensation. B. Kahn and G. E. Uhlenbeck. *Physica*, 5. *pp.* 399–416, *May*, 1938. *In English.*—A discussion is given of Mayer's theory of the condensation phenomenon [see Abstract 979 (1938)]. It is shown that the theory is not restricted to classical statistical mechanics, nor that it is necessary to assume the additivity property of the inter-molecular forces. The theory is based on Ursell's development of the partition function in powers of the volume. Then the reasoning of Mayer is given, which leads to the fundamental equations which represent the equation of state of a non-ideal gas. The analogy is shown between these equations and the equations of Einstein for the ideal Bose gas. For this latter case Einstein had predicted already a condensation phenomenon. Attention is drawn to the analogy between his argument and the reasoning by which Mayer explains the condensation of a vapour. Assuming certain properties of an analytic function $\chi(z)$, which is characteristic for the behaviour of a real gas, a rigorous derivation of the condensation phenomenon is given. AUTHORS.

2513. Thermodynamical Treatment of Stationary Processes in Polyphase Systems. W. Meissner. *Ann. d. Physik*, 32. 1–2. *pp.* 115–127, *May*, 1938.—Equations are derived mathematically, which are necessary for the thermodynamical treatment of stationary processes in polyphase systems and with special reference to applications in technical problems. The examples worked out are the preparations of CO_2 snow by the simple valve reduction of pressure on liquid CO_2, and of compact CO_2 ice (dry ice). H. H. Ho.

2514. Equivalence of Work and Total Heat at the Absolute Zero. M. di Jorio. *N. Cimento*, 14. *pp.* 480–485, *Dec.*, 1937.—It is shown that the two first principles of thermodynamics, independently of the Nernst postulate, lead to the equivalence at the absolute zero of work and total heat, and hence permits of the prediction of some of the properties in transformations at the absolute zero. Such conditions of equality put a limit on the variations in the entropy in such transformation. C. J. B. C.

2515. Thermodynamic Properties of Substances as a Function of Reduced Temperature. H. A. Fales and C. S. Shapiro. *Am. Chem. Soc., J.* 60. *pp.* 784–805, *April*, 1938.—The study of the volume ratio as a function of reduced temperature has led to the formulation of a relationship between latent heat and (reduced) temperature alone, which holds within experimental limits, and also to a functional relationship between pressure and volume and (reduced) temperature. The similarity in the shapes of the graphs, $ln\ P_{cr}/P_s$; $ln\ V_g/V_{cr}$; $ln\ V_g/V_l$ and L_{ev}/T as functions of τ (the reduced temperature) has suggested that all these curves belong to one and the same family of algebraic functions and can be expressed by a common equation, $y = k[(1 - \tau^2)^m/\tau^n]$, differing only in the values of the parameters k, m and n. The reduced vapour pressures of chemically different substances are found to be expressible in terms of reduced temperature within the limits of experimental error and in agreement with the accurate test formulæ used by observers to check their data. The form of the vapour pressure function is found to be entirely analogous to that of the volume ratio. The fact that the reduced vapour pressures are given accurately by the proposed equation is opined to indicate the possibility of defining the behaviour of all substances when compared at equal reduced temperatures. H. H. Ho.

2516. Thermodynamic Derivation of the E.M.F. of a Gas Voltaic Pile. O. Scarpa. *Accad. Lincei, Atti*, 27. *pp.* 3–5, *Jan.* 9, 1938.—The Gibbs-Helmholtz equation $E = J\Delta u/F + T(dE/dT)$, is applicable only for reversible changes at constant volume, while experimental determinations of dE/dT are made at constant (atmospheric) pressure. From the above expression the author deduces the equation $E = J\Delta u/F + T(dE/dT) - nRT/F$, by two different methods; n being the number of molecules in the volume ΔV, and F the number of coulombs generated. If Q_V and Q_P represent the algebraic sum of the heats at constant volume and constant pressure respectively $E = JQ_V/F + T(dE/dT)_{\text{const. P}} - nRT/F$, and $E = JQ_P/F + T(dE/dT)_{\text{const. P}}$. For the Grove ($H_2$–$O_2$) pile at 20° C. and 1 atm., $nRT/F = 0{\cdot}019$ V, $T(dE/dT) = 0{\cdot}293$ V. By the principle of conservation of energy $E = J\Delta u/F - JQ_R/F - nRT/F$, Q_R being the Peltier heat, whence $Q_R = -FT(dE/dT)_{\text{const. P}}/J$. D. R. H.

2517. General Definition of Entropy and Bases of Chemical Thermodynamics. M. W. Mund. *Ann. Soc. Sci. de Bruxelles*, 58. *pp.* 65–86, *March* 19, 1938.—The theorem of Clausius lacks universality in that it assumes uniform temperature throughout the system at each instant. The limitations of this are considered at length, and it is then applied to systems of uniform temperature and concentration in which a chemical action is taking place. The degree of irreversibility is introduced together with the velocity of the reaction, and this leads to a consideration of the chemical potential idea of Gibbs as considered by de Donder. Finally consideration is given to systems which are non-uniform *i.e.*, in which temperature gradients, etc., may occur. The subject is developed vectorially and involves an addition to the degree of irreversibility. E. H. D.

2518. Physico-Chemical States of Equilibrium. J. L. Finck. *Frank. Inst. J.* 225. *pp.* 411–435, *April*, 1938.—The approach to thermodynamic and thermochemical problems in this paper is new, and the fundamental assumptions involved in thermodynamic theory concerning states of physico-chemical equilibrium are considered from the standpoint of the possibility of enlarging the assemblage of states by including states outside those of the range of the mass-action law, and also states of supersaturation. The assumptions are made that all chemical reactions require a catalyst, and that in any given system of matter it is possible, by means of some catalytic agent or agents, to constrain individual atoms and molecules to take and retain any associated or dissociated form by providing them with the necessary energy. Catalysis is thus introduced as a new factor, and it is found possible thereby to enlarge the scope of thermodynamics. It is shown, *e.g.*, that a single gaseous phase is thermodynamically analogous to a liquid–vapour system. The Clapeyron-Clausius equation is generalised to apply to reactions in the gaseous phase, and it is found that van 't Hoff's reaction isochore is a special case of the former equation. In a simple manner the theory is shown to explain endothermic and exothermic reactions, and the critical point. H. H. Ho.

***2519. Thermodynamic Properties of the Hexyl Alcohols. F. Hovorka, H. P. Lankelma and S. C. Stanford.** *Am. Chem. Soc., J.* 60. *pp.* 820–827, *April*, 1938.—An improved apparatus for the determination of viscosity of liquids is described. The viscosity, surface tension, vapour pressure and density of hexanols-1, -2 and -3, and 2-methylpentanol-1 and -4 are determined at temperatures from 5° to their boiling points. The boiling points, heats of vaporisation and Rankine equation constants are calculated from the vapour pressure measurements. They are found to follow the Rankine equation closely. The viscosity results are discussed from the standpoint of the kinetic theory of viscosity. No quantitative results were obtained, but it has been found possible to give a qualitative explanation of the results in terms of different types of association. The parachor, Eötvös constant, and critical temperature of each alcohol are calculated from the surface tension data. It is found that no general conclusions can be drawn from the surface tension measurements. Plans for further study are outlined briefly. AUTHORS.

See also Abstracts 2228, 2247, 2291.

VAPORISATION AND CONDENSATION.

2520. Boiling Points of Benzene, Ethylene Chloride, *n*-Heptane, and 2,2,4-Trimethylpentane. E. R. Smith and H. Matheson. *Bureau of Standards, J. of Research*, 20. *pp.* 641–650, *May*, 1938.—By the comparative ebulliometric method, using water as the reference standard and ebulliometers of the Swietoslawski type, data were obtained from which equations were developed expressing the relation between temperature and vapour pressure from 660 to 860 mm. The use of these substances as reference standards for boiling-point measurements is discussed. Equations for the relative volatilities of the two pairs, benzene-ethylene chloride and *n*-heptane-2,2,4-trimethylpentane, are given. The data show that Dühring's rule and the corresponding reciprocal temperature relationship hold accurately over a limited range of pressures, even for substances of different types.

2521. Evaporation of Concentrated Films of Sodium. R. C. L. Bosworth. *Cambridge Phil. Soc., Proc.* 34. *pp.* 262–271, *April*, 1938.—A three-filament mechanism is described which will enable multimolecular films to be studied by the method of contact potentials and this method is applied to the study of the evaporation of Na films of various thickness from 1 to 20 layers. It is shown that the vapour pressure and heat of evaporation both increase as the thickness increases from one to three layers and thereafter become practically independent of any further increase in the film thickness. The vapour pressure for a thickness of four layers is within experimental error the same as that for bulk Na. A difficulty due to the effect of the evaporating stream of atoms annulling the space charge around the emitter filament is discussed, and attempts are made to use this effect to measure the rate of evaporation at temperatures from 500° K. to 825° K. AUTHOR.

2522. Extension of Nusselt Theory of Heat Interchange at Condensation. G. Krujilin. *Techn. Phys., U.S.S.R.* 5. 1. *pp.* 59–66, 1938. *In English.*—In 1916 Nusselt published solutions for the heat interchange which accompanies the condensation of steam as a film on the surface of a vertical plate and a horizontal circular cylinder. The present author points out that no account was then taken of the forces of inertia acting on an element moving in the film of the liquid. This factor is introduced in the present treatment, but this refinement is found to lead to formulæ in close agreement with those of Nusselt. R. W. P.

2523. Dissociation Pressures of the Hydrides and Deuterides of Rubidium and Cæsium. A. Borocco. *Comptes Rendus,* 206. *pp.* 1117–1118, *April* 4, 1938.—In a previous paper [see Abstract 793 (1938)], the author has shown that the respective dissociation pressures of the deuterides of Na and K are greater than those of the corresponding hydrides. A similar result is now shown to hold for the deuterides and hydrides of Cs and Rb. Calculated and measured values of the respective pressures are tabulated for the temperature range 190°–330° C. J. S. G. T.

***2524. Effect of Intermolecular Forces in Gases and Liquids. E. Steurer and K. L. Wolf.** *Zeits. f. phys. Chem.* 39. *Abt.B.* 2. *pp.* 101–125, 1938.—An apparatus for the determination of gas and vapour pressures is described. It has been used for the determination of the pressure of the unsaturated vapours of a number of alcohols, ketones, and hydrocarbons. The dependence of the association of the vapours of CH_3OH, CH_3COCH_3, C_6H_{14}, cyclohexane, and C_6H_6 on pressure was determined. The molecular weights of some alcohols in non-polar solvents were also determined, and the degree of ordering of the molecules in the gaseous and liquid state was obtained. From this a comparison of the effect of intermolecular forces in gases and liquids is made. A. J. M.

See also Abstracts 2510, 2519.

ACOUSTICS.

2525. Distortion of a Sound Field by a Rigid Sphere. H. Stenzel. *E.N.T.* 15. *pp.* 71–78, *March,* 1938.—Previous calculations of the distortion of a sound field by a rigid sphere deal only with the cases in which either the source of the sound or the point at which the sound is measured lie on the surface of the sphere. The author deals with the case in which both points are at great distances from the surface of the sphere. The necessary Bessel functions are tabulated and the distorting effect of the sphere is calculated. The results are shown graphically in the form of polar curves. K. M. C.

2526. Periods of Longitudinal Vibration of Steel Cones and Truncated Cones. G. W. Pierce and A. Noyes, Jr. *Acoustical Soc. of America, J.* 9. *pp.* 301–307, *April,* 1938.—An account of the measurement of the frequencies of cones and truncated cones of nickel-steel and stainless steel, with an investigation of the formula which relates the frequency to the dimensions of the cone and the velocity of longitudinal waves in the cone. Fundamental and overtone frequencies were measured by a twin magnetostriction oscillator, and it was found that, for a given ratio of the end diameters, the dynamic overtone frequencies are nearly linearly related to the overtone numbers. The fundamental frequency of a truncated cone is always higher than the frequency of a uniform cylinder of the same length and material, and is a function of the ratio of the end diameters. The ratio of the fundamental of a truncated cone to the fundamental frequency of a cylindrical rod of the same length and material changes from 1·000 to 1·4303 as the ratio of the end diameters changes from 1 to infinity. [See also Abstract 1699 (1938).] G. E. A.

2527. Bells. J. Arts. *Acoustical Soc. of America, J.* 9. *pp.* 344–347, *April*, 1938.—An account of experiments using bells, tuning forks and aural judgment to study the pitch of the strike note, of an elusive bell tone and the effect of temperature change. W. H. G.

2528. Undertones. E. Waetzmann and R. Kurtz. *Ann. d. Physik*, 31. 7. *pp.* 661–680, *April*, 1938.—In sound recording and repeating apparatus there occur besides overtones also undertones or subharmonics. Subjective undertones such as might be produced in the ear do not appear to exist. The Melde fork and thread experiment is cited as an instance of an objective undertone. The paper describes observations on undertones produced in the carbon microphone the electromagnetic telephone and in strings. In W. Moser's experiments on the microphone, the sub-octave of the exciting tone appeared and became louder with rise of frequency until at frequency 900 the undertone was louder than the exciting tone. Oscillograms are reproduced of undertones $n/2$ and $n/4$ obtained from a hum-note of frequency $n = 2150$ applied to a microphone. Similar results are shown for undertones in an electromagnetic telephone, analysis indicating the presence of the tones n, $n/3$, $2n/3$, $4n/3$ and $5n/3$. A theoretical treatment of the effects is given. G. E. A.

2529. Tones Produced by a Wire in a Gas Flame. J. J. Coop. *Acoustical Soc. of America, J.* 9. *pp.* 321–330, *April*, 1938.—A wire placed in a gas flame produces, under certain conditions, a musical tone. The frequency of the tone depends on the diameter of the gas orifice, the diameter of the wire and its distance from the orifice and is directly proportional to the velocity of the gas. The tone is observed only when the gas is ignited, but it is suggested that vibrations so small as to produce no audible effect are present in the unignited gas. The tone produced in the ignited gas is attributed to a series of miniature explosions produced by the formation of vortices behind the wire, the phenomenon being related to that of Aeolian tones. K. M. C.

2530. Dispersion of Acoustic Velocity in Liquids. B. V. R. Rao. *Indian Acad. Sci., Proc.* 7A. *pp.* 163–175, *March*, 1938.—The present paper deals with the acoustic velocity determinations of " hypersonic " waves ($> 10^9 \sim$) by a study of the fine structure of the radiations scattered by liquids under suitably controlled experimental conditions like the use of a specially designed, low density, kathode-cooled, Hg vapour lamp and a proper selection of the invar distance piece of the etalon employed with reference to the sound velocity in the particular liquid under examination and the radiation employed. The results indicate the presence of dispersion of acoustic velocity in liquids with frequency in the case of two typical liquids like CCl_4 and acetone which have stood the test of careful repetition and scrutiny. These results are discussed at some length and their bearing on the hitherto unexplained anomalous acoustic damping in liquids in the " ultra-sonic " ($< 10^9 \sim$) region is indicated. AUTHOR.

2531. Velocity of Sound in Liquid Nitrogen. E. Hirschlaff. *Cambridge Phil. Soc., Proc.* 34. *pp.* 296–298, *April,* 1938.—This note describes measurements of the velocity of sound in liquid N_2 by a method which has previously been used in the case of liquid O_2 [see Abstract 5215 (1936)]. The method depends on the diffraction of light by supersonic waves.

2532. Wave Phenomena in Models Using Supersonic Waves. S. Kretschmer and S. Rshevkin. *Techn. Phys., U.S.S.R.* 4. 11–12. *pp.* 1004–1019, 1937. *In English.*—The authors point out that wave phenomena in models may be more conveniently studied by the use of supersonic waves in liquids than by other methods. An arrangement is described in which pictures may be obtained of the propagation of supersonic waves in a liquid filling a transparent vessel of sufficiently large dimensions to contain the models. The optical system is essentially that used by Toepler in the study of waves produced by impulses in air. Numerous photographs are given showing the reflection, diffraction and interference of supersonic waves; reflection from models representing interiors of auditoria is also studied. K. M. C.

2533. Supersonic Waves in Liquids under Pressure. P. Biquard. *Comptes Rendus,* 206. *pp.* 897–899, *March* 21, 1938.—The velocity of propagation and the coefficient of absorption of supersonic waves in liquids is measured at pressures up to 700 kg./cm^2. A quartz emitter is placed in the upper part of a vertical pressure chamber which is provided with 14 windows at different levels to allow the passage of light through the liquid at different distances from the quartz. The separation of the usual diffraction bands is proportional to the velocity of sound in the liquid. The velocity relative to that at atmospheric pressure is given for benzene, toluene, CCl_4, and methyl acetate. The velocity is proportional to the pressure except when the liquid nears solidification point. K. M. C.

2534. Diffraction of Light by Supersonic Waves in Solids. N. S. N. Nath. *Cambridge Phil. Soc., Proc.* 34. *pp.* 213–223, *April,* 1938.—A theoretical investigation of the optical diffraction effects due to two sound waves which pass in the same direction through a glass block. To illustrate the method and justify its applicability there is first investigated the diffraction of light by two parallel longitudinal sound waves in a liquid. There is next considered the diffraction of light in a glass block due to two parallel sound waves, one of them longitudinal and the other transverse. Results are obtained which are in agreement with the experimental results of Hiedemann and Hoesch, and also show the existence of combination orders. [See Abstract 1306 (1937).] G. E. A.

2535. Absorption of Supersonics in Liquids by an Optical Method. H. Grobe. *Phys. Zeits.* 38. *pp.* 333–338, *April* 15, 1938.—Light from a Hg lamp was passed through a green glass, then in parallel rays through the sound field of a quartz or tourmaline, and an image of the field was formed on a photographic plate by diffracted light of the first order. The method rests on the principle that with sufficiently low sound intensity the light diffracted by the sound waves is proportional to the sound energy. Absorption coefficients are tabulated for benzol, CCl_4, toluol, ethyl alcohol and water. The general result is that the absorption is proportional to the square of the frequency. The values found for the absorption are, however, very much greater than those given by the classical theory. The effects of temperature and concentration on absorption were also measured. G. E. A.

2536. Diffraction of Light by Supersonic Waves in Solids. E. Hiedemann. *Zeits. f. Physik,* 108. 9–10. *pp.* 592–597, 1938.—The diffraction of polarised light by supersonic waves in glass is investigated and found to be in agreement with the theory of Nath and Mueller [*Nature,* 141. *p.* 37. *Jan.* 1, 1938]. R. P.

2537. Sound Absorption and Attenuation by the Flue Method. H. O. Taylor and C. W. Sherwin. *Acoustical Soc. of America, J.* 9. *pp.* 331–335, *April,* 1938.—A method of determining acoustical absorption coefficients is described, which is essentially the same as that in an earlier paper [see Abstract 295 (1914)]. Sound " flues " are used, a flue being a pipe about 5–11 in. square. The flues are about 6 ft. long, closed at one end, and lined completely with material the sound absorption of which is required. A telephone receiver or a Magnavox movement connected to an oscillator provides a source of sound at the open end, and a probe tube connected to a telephone receiver explores the intensity of sound along the axis. When reflection at the closed end cannot be neglected a standing wave system is created in the flue. The absorption coefficient is calculated from the maximum and minimum intensities of this system. The attenuation per ft^2. of lining material in the flue is also obtained. K. M. C.

2538. Loudness, Masking and their Relation to the Hearing Process and the Problem of Noise Measurement. H. Fletcher. *Acoustical Soc. of America, J.* 9. *pp.* 275–293, *April,* 1938.—The experimental and analytical methods which have been used by various workers to reduce loudness to a quantitative basis are discussed. Tests are described in which the loudness level (in phons) of a complex tone having 10 components of equal individual loudness level is compared with the loudness level of each component. The complex tone is shown to be 10 times as loud as each component, which is in agreement with the independent results of other workers and which suggests that the patches of nerve stimulation corresponding to each component do not overlap. A loudness scale based on this result is constructed. A method is given, based upon masking measurements of thermal noise, of determining a position coordinate X of the auditory nerve patch which is most excited by a tone of any one frequency. Methods are described of calculating the loudness of a tone or noise when heard by a normal and by a deafened ear. K. M. C.

2539. M.K.S. Units in Electro-Acoustics. A. E. Kennelly and J. H. Cook. *Acoustical Soc. of America, J.* 9. *pp.* 336–340, *April,* 1938.—As the practical electrical units and the mechanical c.g.s. units do not form a homogeneous system, unwieldy transformation coefficients occur in all electro-acoustic work. They are avoided by using the M.K.S. system. The relationship between the old and the new systems is presented in a table and an electro-acoustical problem is worked out in detail by way of illustration. W. H. G.

*__2540. Ripple Tank Photography. M. E. Raquet and F. R. Watson.__ *Acoustical Soc. of America, J.* 9. *pp.* 352–353, *April,* 1938.—Surface tension effects can distort the wave patterns in ripple tank experiments so that the photographs appear confused. It is suggested that this arises from the fact that the water meniscus formed at the sides of the obstacles in the tank acts as a lens. A method of eliminating this distortion, by getting rid of the meniscus, is described. It is arranged that the obstacles are just submerged so that they are covered by a layer of water so thin that the ripples are completely reflected. Care must be taken that the upper and lower surfaces of the obstacles and the bottom of the tank are perfectly plane and parallel and that no traces of grease are present. Photographs of ripple systems with and without this treatment are given. K. M. C.

See also Abstracts 2220, 2221, 2485 and

2064B. Reverberation Time and Sound Intensity by Fluxmeter. R. Fleurent and M. Beauvilain.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2541. Operational and Matrix Methods in Linear and Variable Networks. L. A. Pipes. *Phil. Mag.* 25. *pp.* 585–600, *April*, 1938.—A general method is given for the solution of problems arising in the analysis of linear circuits whose parameters vary with the time. Part I of the paper deals with circuits in which the parameters vary continuously with the time in a known manner; such circuits of practical importance as the microphone transmitter and the induction generator come under this heading, and also many mechanical problems of variable stiffness or mass. Part II discusses linear lumped circuits whose parameters are fixed throughout definite time intervals but are then abruptly changed to new values at certain definite times. General switching operations are examples coming under this category. It is shown in the paper how the Laplacian transformation or operational method of solving differential equations encountered in circuit theory may be extended to the solution of systems with parameters varying with the independent variable subject to certain limitations. The use of matrix notation combined with the Laplacian transformation has many advantages on account of the symmetry and convenient arrangement of the operations. [See Abstracts 804 and 1265 (1938).] J. J. S.

See also Abstract 2577.

CONDUCTION AND DISCHARGE IN GASES.

2542. Transport of Ions in Gas at Supersonic Velocity. V. Volkovisky. *Comptes Rendus,* 206. *pp.* 1084–1086, *April* 4, 1938.—Electrodes A, B are placed at two points, (*a*) opposite, or (*b*) both on one side of a tuyère just above the narrowest portion, and two other electrodes, C, D, connected through a battery and ammeter, are placed higher up. Air is blown along the tuyère from A and B past C and D, and a.c. or d.c. is passed across the gap between A and B, while between C and D a p.d. of 500 V is maintained. If there is no p.d. here the phenomenon is the same but much less marked. When the velocity of the air is sufficiently great a current passes between C and D, and is more intense in case (*b*) than in (*a*). Applications in aerodynamics are suggested. C. A. S.

2543. Transport of Ions by Current of Gas. Expansion of Gas when Ionised. M. Moreau-Hanot. *Comptes Rendus,* 206. *pp.* 1168–1170, *April* 11, 1938.—Ions were carried along tubes of insulating material

of varying diameter and length, by a current of air of velocity 15 – 125 m./sec. into a second tube of conducting material (the " collector ") connected to earth through an ammeter, and the current thus measured. Calculation gives the expansion due to mutual repulsion of ions of like sign, and thence the actual current that should be carried by the ions that reach the collector. Experimental results show that this current is of the right order of magnitude, though considerably less than theoretical; and that this method would only give a satisfactory method of conveyance if a heavy vapour, in which the mobility of the ions was small, were used.
C. A. S.

2544. Development of the Spark Discharge. T. E. Allibone and J. M. Meek. *Roy. Soc., Proc.* 166*A*. *pp.* 97–126, *May* 4, 1938.—A general account is given of the development of the h.v. electric spark, based on the study of over 1000 photographs taken with a rotating film camera. The electric spark is shown to consist of two principal components, a leader stroke and a main stroke—analogous to the lightning flash. A leader stroke invariably starts from a positive electrode, and sometimes also starts from a negative electrode: sometimes the structure of the leader stroke is simple, sometimes it is of the " stepped " variety. The leader stroke is always branched at many places, and the direction of branching is the direction of its propagation in space: branching thus forms a criterion of the direction of leader-stroke development. The main stroke develops in the reverse direction to that of the leader stroke and at a velocity too high to be recorded. The velocities of the positive and negative leader strokes are of the order of 10^6–10^7 cm./sec., the positive leaders being the faster. Oscillograms of current and voltage support the photographic results. Multiple stroke discharges have been produced and show the characteristics of the multiple lightning flashes: the first is initiated by a slow leader stroke and is branched, the subsequent main strokes are either without leader strokes or the resolution of the camera is inadequate to show them: they are not branched. AUTHORS.

2545. Quantitative Measurements of Intense Condenser Discharges in Hydrogen at Reduced Pressure. E. Blum. *Ann. d. Physik*, 31. 7. *pp.* 585–599, *April*, 1938.—The maximum current $I_{\max.}$ in an impulsive condenser discharge is measured by a method described previously by the author and Finkelnburg [see Abstract 1380B (1937). A valve method of measuring $(\frac{dI}{dt})_{\max.}$ for both rising and falling current is described. Two methods of determining the duration of a current impulse are described and compared with Bay's method [see Abstract 5234 (1936)]. Results of measurements of intense current discharges by these methods are communicated. For the same striking potential and with a few ohms in the discharge circuit the value of $I_{\max.}$ is independent of the gas pressure, p, and the sparking distance d, if the product pd is constant in the case of discharge tubes not smaller than 2·5 mm. dia. $I_{\max.}$ is exponentially dependent on the resistance R in circuit for constant striking potential. It is shown how the condenser voltage corresponding to $I_{\max.}$ and the time to reach $I_{\max.}$ may be calculated from the dependence of $I_{\max.}$ on R. The voltage maintaining a discharge of 20 cm. length in a 1 mm. tube is found to be many times greater than the voltages across tubes greater than 2·5 mm. dia. $(\frac{dI}{dt})_{\max.}$ increases with striking potential. For the same striking potential $(\frac{dI}{dt})_{\max.}$ decreases with increasing sparking distance. J. E. K.

2546. Breakdown in Vacuum Tubes at High Voltages. H. Neuert. *Phys. Zeits.* 39. *pp.* 309–313, *April* 1, 1938.—Observations have been made on the b.d.v. inside glass-walled vacuum tubes at gas pressures in the region of 10^{-4} mm. Hg using voltages between 100 and 180 kV. The electrodes used in most of the experiments were of the type used in kathode-ray work. Curves are given showing the variation of voltage with breakdown distance between the electrodes and the tube wall. The breakdown distance varies non-linearly with voltage from 6 cm. at 100 kV to 22 cm. at 180 kV. Experiments with a ribbed porcelain cylinder indicate that increasing the surface insulation of the tube gives no increase in the b.d.v. inside the tube. When the potential fall along the inside of the tube is made uniform by painting on a spiral high resistance of graphite (10^{10} ohms) the b.d.v. between electrodes and wall becomes almost exactly proportional to the distance. A number of observations are also recorded of the b.d.v. between tubular electrodes of different curvatures. J. E. R.

2547. Critical Potentials of CO. J. Savard and M. de Hemptinne. *Comptes Rendus,* 206. *pp.* 998–1000, *March* 28, 1938.—Critical potentials previously interpreted [see Abstract 2757 (1937)] by combinations of simple resonance potentials are compared with experimental results, obtained by electronic bombardment, for activation energies of different states, and satisfactory agreement is found. Results are discussed in relation to the Franck-Condon theory. N. M. B.

2548. Scattering and Dissociation of Slow Ions. F. Wolf. *Ann. d. Physik,* 31. 6. *pp.* 561–568, *March,* 1938.—Using a method previously described [see Abstract 324 (1937)] the effective cross-sections for a further series of ionic collisions have been investigated. These are $H_2^+ \rightarrow N_2$, $N_2^+ \rightarrow H_2$, $N_2^+ \rightarrow He$, $N_2^+ \rightarrow Ne$, $N_2^+ \rightarrow A$. In a theoretical discussion of the results, the important part played by dissociation is pointed out. J. E. R.

2549. Sensitivity of the Balanced Space-Charge Method for Detecting Ionisation of Gases by Collision of Ions and Atoms. A. Rostagni. *Phys. Rev.* 53. *pp.* 729–731, *May* 1, 1938.—Factors which influence the balanced space-charge method of detecting ionisation are discussed. These factors are (1) the velocities of the ions, (2) the distances travelled by the ions before they are neutralised, (3) the effect of secondary electrons on the space charge. It is concluded that the reduced sensitivity in some experiments may account for the failure to observe ionisation. [See following Abstract.] AUTHOR.

***2550. Sensitivity of Balanced Space-Charge Positive Ion Detector. R. N. Varney.** *Phys. Rev.* 53. *pp.* 732–734, *May* 1, 1938.—Additional information is given on the reaction of the balanced space-charge detector to fast positive ions in the presence of gas in the tube. The sensitivity of the detector is analysed, primarily in terms of experimental observations. Further notes on the mechanism of the detector are added. [See preceding Abstract.] AUTHOR.

***2551. Electron-Optical Theory of Precision Mass Spectrographs. R. Herzog and V. Hauk.** *Zeits. f. Physik,* 108. 9–10. *pp.* 609–634, 1938. By application of electron optical theory to a general combination of a radial electric field and a homogeneous magnetic field a formula is derived for the curve on which positive rays of different velocities intersect. This curve, representing the condition for velocity focusing, and the curve for direction focusing are calculated for the mass spectrographs used by Bainbridge and Jordan, Dempster, and Aston and are compared in relation to the actual dispositions of the photographic plates in these instruments. The theory of Aston's apparatus is extended to arbitrarily large angles of deflection and some suggestions are made for improvement of the resolving power and the intensity. J. E. K.

2552. Corpuscular Rays. Part II. A. Becker. *Die Physik*, 6. 2. *pp.* 55–77, 1938.—This report comprises a comprehensive summary, with references to close on 400 original papers, of the progress in corpuscular-ray research since the issue of Part I of the report 4 years ago [see Abstract 2595 (1934).] The scope of the report is indicated by the following sub-headings: I. Kathode Rays: (1) electron optics, (2) electron scattering; II. Positrons. III. Matter Rays: (1) α-rays, (2) protons and deuterons, (3) other carrier rays, (4) atomic and molecular rays, (5) neutrons. J. E. K.

2553. Chemical Effect of Electrical Discharge in Gaseous Hydrocarbons. Part IX. S. C. Lind and G. R. Schultze. *J. Phys. Chem.* 42. *pp.* 547–558, *April*, 1938.—The condensation of ethane, propane, butane, and propylene under influence of electrical discharge has been studied with special consideration of its dependence upon the time. A number of principles, which shed further light upon the extremely complex nature of electrical condensations, have been derived from detailed analyses of the reaction products. The decisive differences between saturated and unsaturated hydrocarbons place paraffins and olefins in two different groups. More comprehensive data are offered to substantiate the group characteristics of these gases with special reference to different lengths of time. A comparatively long induction period is found for each one of the gases investigated. A comparison of different rates has been given for the electrical condensation of methane, ethane, propane, butane, ethylene, propylene and acetylene. The product of molecular ionisation and of the chemical yield under α-radiation checks most closely the results obtained and is considered to be the governing factor for the electrical condensation of gaseous hydrocarbons. [For Part VIII see Abstract 1036 (1932).] AUTHORS.

2554. Recombination of OH Radicals in the Electric Discharge. V. Kondratjew. *Acta Physicochimica*, 8. 3. *pp.* 315–322, 1938. *In English.*—It is shown that the most probable process governing the destruction of OH radicals in the zone of an electric discharge in water vapour is $2OH + M = H_2O_2 + M$. The calculated value of the OH recombination constant agrees satisfactorily with the measured value. The fact that it is impossible to observe H_2O_2 formed as a result of the recombination of OH is attributed to secondary reactions between H_2O_2 and either H or OH leading to its decomposition. [See Abstract 3178 (1937).] AUTHOR.

2555. Clean-Up of Inert Gases in an Electric Discharge. Parts II and III. H. Alterthum and A. Lompe. *Zeits. f. techn. Physik*, 19. 4. *pp.* 113–118, 1938.—It has been found previously [see Abstract 321 (1937)] that the clean-up is due to the inert gas atoms entering into the kathode. A new method of investigation is developed in which the time taken by the discharge tube to become hard is measured. The effect does not depend on the shape of the kathode and on the crystalline structure of the kathode metal. The dependence on the kathode fall is studied. The effect depends strongly on the kathode material. Experiments with hollow kathodes in which the bottom is made of a different metal from the walls show that the bottom plays no predominant part in the phenomenon. R. P.

***2556. Apparatus for the Purification of the Inert Gases and Hydrogen. W. Weizel.** *Zeits. f. techn. Physik*, 19. 5. *pp.* 146–148, 1938. An apparatus, based on discharge at Mg electrodes which is spectrally controlled, is described in detail. It ensures the complete and rapid removal of N_2 from mixtures of A, He and Ne, and affords spectrally pure H_2 from illuminating gas. From the latter gas CO disappears in 1 min. and N_2 in 10 min. H. H. Ho.

2557. Electrophysics of Gases. Part II. G. Mierdel and R. Seeliger. *Die Physik*, 6. 2. *pp.* 79–100, 1938.—The six sections of this paper are as follows: (1) Carriers of charge in gases:—(*a*) Carrier formation. Ionisation by electron impact, by impact of positive carriers, neutral and metastable atoms and by absorption of radiation. Carrier formation at boundary surfaces of solids. (*b*) Transformation and disappearance of carriers. (*c*) Carrier motion. Kinetics of free electrons and of ions. (2) Stationary glow and arc discharges:—(*a*) Anode and kathode fall regions. (*b*) Special features of the discharge near the electrodes. (*c*) Plasma. General theory of plasma; probes; thermal and diffusion effects; l.v. arcs. (*d*) Miscellaneous effects. (3) Non-stationary discharges:—(*a*) Ignition initial potentials. Mechanism of ignition. (*b*) General dynamics of such discharges; building-up phenomena; special discharge forms. (4) Corona discharges. (5) H.F. discharges. (6) Miscellaneous. (*a*) Chemical effects. (*b*) Electric gas purification. (*c*) Conduction of flames. [For Part I see Abstract 2588 (1934).] A. W.

See also Abstracts 2393, 2403, 2404, 2405, 2407, 2408, 2461, 2481, 2482.

CONDUCTION IN SOLIDS AND LIQUIDS.

2558. Conduction by Convection and Diffusion in Cylindrical Arrangements. F. Borgnis. *Ann. d. Physik*, 31. 8. *pp.* 745–754, *April*, 1938.—The problem is dealt with by rigorous consideration of the diffusion. For the special case of vanishing field strength at one electrode an approximate solution is given, which holds with sufficient accuracy, in many cases where the radii of the cylinders and the current are not too small. [See Abstract 3301 (1936).] R. L.

***2559. Improved Circuit for the D.C. Amplifying Valve of a Valve Voltmeter. R. E. Burgess.** *Journ. Sci. Instruments*, 15. *pp.* 171–174, *May*, 1938.—In this note it is shown that the dependence of calibration of a valve voltmeter using a d.c. operated amplifying valve, upon the anode battery voltage may be considerably reduced by the correct choice of galvanometer resistance with respect to the valve characteristics. Details of the method are given in the paper together with a sample of results showing the extent to which changes of calibration can be minimised in practice. AUTHOR.

2560. Rectifying Action of Semiconductors. B. Davydov. *Techn. Phys., U.S.S.R.* 5. 2. *pp.* 87–95, 1938. *In English.*—The conditions are considered under which a current passes through a contact between two electronic semiconductors, possessing conductivities of different type (free electrons and " holes "). It is shown that, according to the direction of the current, there is an increase or decrease in the concentration of free charges near the contact. The result is rectification. General diffusion equations are solved for one special case. The formulæ thus obtained give satisfactory agreement with the known data for the Cu_2O rectifier, if it is assumed that the blocking layer possesses normal electronic conductivity.

Rectification must be accompanied by a thermal effect, associated with the dissociation and recombination of free electrons and "holes." It is shown that the theories of rectification previously proposed (tunnel effect, cold emission) cannot explain the observed phenomena. AUTHOR.

2561. Resistance of Supraconducting Cylinders in a Transverse Magnetic Field. A. D. Misener. *Roy. Soc., Proc.* 166*A*. *pp.* 43–55, *May* 4, 1938.—Detailed experiments on the transition of polycrystalline cylindrical wires from the supraconducting to the normal state in a uniform transverse magnetic field are described. Several specimens each of Sn, In and Pb of high purity were investigated. The applied field strength (H_t) which restored the first traces of electrical resistance was accurately determined at various temperatures below the normal transition point. It is found that the ratio of this field to the critical field (H_k) corresponding to the temperature of the experiment is not constant but varies with the temperature. The variation is linear, the ratio H_t/H_k increasing as the temperature is decreased. For all specimens the ratio H_t/H_k would have the value $0 \cdot 50$ at the normal transition point. It is considered that this effect is incompatible with the idea of an "intermediate state" existing in a long cylinder, and an explanation is offered based on the assumption that after penetration of the external magnetic field (above $0 \cdot 50\ H_k$) the cylinder breaks up into macroscopic regions of normal and supraconducting material. The agreement of this hypothesis with previously observed phenomena is discussed. A preliminary experiment is reported in which, by measuring the resistance of successive millimetre sections of a specimen, the coexistence of these normal and supraconducting regions is shown directly. AUTHOR.

2562. Electrical Properties of Manganese Ferrites. A. Schulze and W. Gremmer. *Phys. Zeits.* 39. *pp.* 205–208, *March* 15, 1938. *From the Reichsanstalt.*—The electrical resistance of the Mn ferrites is extremely high at room-temperature but it decreases so rapidly as the temperature is raised that, at high temperatures, it has the resistance of a badly conducting metal. The formation of intercrystalline layers is postulated to account for this property. H. J. H. S.

2563. Electrical and Thermal Investigation on Manganin. Part II. A. Schulze. *Phys. Zeits.* 39. *pp.* 300–304, *April* 1, 1938. *From the Reichsanstalt.*—In continuing the investigation into the properties of manganin [see Abstract 4657 (1937)] observations are made of the dependence of the room-temperature tensile strength and thermoelectric properties of this material on the temperatures at which the specimens have been aged. These new results confirm those previously obtained, and indicate that manganin wire for use in resistances should be annealed at about 400° C. Measurements made at monthly intervals are recorded of the resistance values of a number of 1Ω and 10Ω manganin resistance units aged in this way. The variation of resistance with time is seen to be less for these than for the original manganin resistances which had been aged at 140° C., also the temperature coefficient of resistance is smaller. R. W. P.

2564. Electrical Properties of Metal Films. E. Perucca. *N. Cimento*, 14. *pp.* 506–524, *Dec.*, 1937.—The films considered are such as may be produced by kathode sputtering or evaporation *in vacuo*, and of maximum thickness of some hundred Ångström units. It has not been possible to decide definitely whether the density of such metallic layers is the same as that for metal in the block. It has been observed that such layers behave in an anomalous way. They show anomalous electrical conductivity, ferromagnetic properties, Hall effect, Thomson-Lenard effect, photoelectric effect, and supraconduction. The reason for such anomalies is considered and more particularly in connection with the electrical conductivity. The paper is largely a review of the work of the writer and other experimenters. C. J. B. C.

2565. Electrical Conductivity of Thin Metallic Films. Part III. Alkali Films with Properties of Normal Metal. A. C. B. Lovell. *Roy. Soc., Proc.* 166*A*. *pp.* 270–277, *May* 19, 1938.—The technique previously described for measuring the electrical conductivity of thin films deposited by evaporation, in very high vacua, on clean substrates, has been modified to include the deposition of thick films of the alkali metals. Cs films 10000 Å thick have resistivities only 4% greater than the bulk metal, and identical temperature coefficients. Thick Rb and K films have rather higher resistivities, but possess the same temperature coefficients as the bulk metal. Evidence is produced that the films are polycrystalline, and that the higher resistivities are due to a simple residual resistance. The gradation in properties of the thick films is shown to follow consistently from the properties of the very thin films investigated previously. From these results and other considerations it is concluded that there are no grounds for the belief that thin films differ essentially in structure from the normal metal. [For Part II see Abstract 1338 (1937)]. AUTHOR.

2566. Dependence of Conductivity of Strong Electrolytes on Frequency and Field Strength. H. Falkenhagen and H. Fleischer. *Phys. Zeits.* 39. *pp.* 305–309, *April* 1, 1938.—From considerations of the theory of interionic attraction, the effect of frequency and field strength on the conductivity of strong electrolytes is calculated. The theoretical curves connecting conductivity with frequency and field strength are shown to be in good agreement with experiment. E. R.

2567. Conductivity of Mixtures of Salts in Water. C. W. Davies. *Chem. Soc., J. pp.* 448–453, *April*, 1938.—The available data for the conductivities of binary mixtures of salt solutions in water have been examined in the light of the dissociation constants derived in previous parts of this series. The large departures from additivity found with certain mixtures are always in the direction, and of the approximate magnitude, to be expected on account of mass-action effects, and therefore confirm in a semi-quantitative way the previous work on the incomplete dissociation of aqueous salt solutions. It is shown, on the other hand, that the absence of such deviations cannot be interpreted as evidence of complete dissociation. AUTHOR.

2568. D.C. Conductances of KCl Solutions. L. V. Andrews and W. E. Martin. *Am. Chem. Soc., J.* 60. *pp.* 871–873, *April*, 1938.—The equivalent conductances of KCl solutions are measured from 0·01 to 0·0005 *N*. A new method of measuring conductances is presented and is upheld by results of sufficient accuracy to substantiate it. AUTHORS.

2569. Resistance of Cu_2O in Fields of High Strength. F. P. Henninger. *Phys. Zeits.* 39. *pp.* 216–224, *March* 15, 1938.—Deviations from Ohm's law in semiconductors under normal conditions may be explained hitherto in all cases by transition resistances dependent on potential or by insufficient constancy of temperature. A semiconductor for which (up to 250 V/cm.) Ohm's law observably holds good is Cu_2O. The chief results now stated are as follows: (1) By the single spark method the resistances of massive fine and coarse pieces of crystalline Cu_2O were measured at high apical field strengths (up to 115 kV). [See Abstract 4282 (1931) (2) Fine crystalline plates follow Ohm's law up to about 90 kV/cm. apical field strength. A coarsely crystalline slab exhibited a resistance independent of potential up to 115 kV/cm. (3) To make sure that the full field strength bore on the oxide itself a plate with single crystals passing right through was measured. Its resistance up to 90 kV/cm. apical field-strength was independent of voltage. It is shown that in porous and badly grown plates anomalies originate through transition resistances dependent on voltage, apart from which the resistance is independent of the potential. With a critical apical field strength (min. about 50 kV/cm. max. about 120 kV/cm.) the hitherto constant resistance of the strips of Cu_2O breaks down spontaneously and irreversibly. J. J. S.

See also Abstracts 2355, 2501 and

1833B. Sharp Cut-off in Valves, with Application to Slide-Back Voltmeter. C. B. Aiken and L. C. Birdsall.
1837B. Salt Content by Conductivity Measurement. W. Schuh.
1840B. Resistance Measurement with Parallel Wires. H. Bruckmann.

DIELECTRICS AND CAPACITANCE.

2570. Solvent Effect in Dielectric Polarisation. Part III. G. Thomson. *Chem. Soc., J. pp.* 460–464, *April*, 1938.—The polarisation of ethyl alcohol has been measured in *iso*propyl, *n*-butyl, and amyl ethers and in dioxan. The high values of polarisation at infinite dilution and the variation of polarisation with concentration are explained by formation of a hydrogen bond between the ether and the alcohol. Evidence in support of this view is adduced from cryoscopic measurements in other ethers. [For Parts I and II see Abstract 4165 (1937).] AUTHOR.

2571. Dielectric Constant of BCl_3 and $AsCl_3$ Vapours. U. Grassi. *N. Cimento*, 14. *pp.* 461–473, *Dec.*, 1937.—A study of the dielectric polarisation of PCl_3 has shown that the trend of the dielectric constant with temperature deviates from the Debye formula. Two constants of the formula are found actually to vary; one of these the value of the permanent dipole increases with temperature. This may be ascribed to an internal modification of the molecule caused by the gradual passage, under the influence of temperature, from an unexcited state to a state of excitation of the Cl atoms. Measurements are made for BCl_3 and $AsCl_3$, and a theoretical formula is derived which accounts more satisfactorily for the temperature variation. C. J. B. C.

2572. Dipole Moment and Free Rotation. A. Riedinger. *Phys. Zeits.* 39. *pp.* 380–384, *May* 1, 1938.—The dipole moments of saturated hydrocarbons with various H atoms substituted by C_6H_5 have been determined in C_6H_6 solution in order to discover the effect of the separation of the substituents on the moment. Even when the separation is small the effect has practically disappeared, so that the polar groups can rotate freely. The $-CH_2-$ chains can also rotate. There is also an independent arrangement of the substituents in the direction of the electric field, which explains the high moments shown by 1 : 3 : 5-triphenylpentane, 1 : 5 : 9-triphenylnonane, and 1 : 3 : 5 : 7-tetraphenylheptane. A. J. M.

2573. Dielectric Constant of Rochelle Salt. D. Doborzynski. *Acad. Polonaise Sci. et Lettres, Bull.* 1–2*A. pp.* 37–61, *Jan.–Feb.*, 1938. *In German.*—An account of some measurements of the dielectric constant of Rochelle salt by the ponderomotive force method. [See also Abstract 319 (1938).] P. V.

2574. Dielectric Properties of Manganese Ferrites. E. Blechschmidt. *Phys. Zeits.* 39. *pp.* 212–216, *March* 15, 1938. *From the Reichsanstalt.*—An examination is made of the dielectric properties of mixtures of paraffin with graphite and with Cu, of Fe powder and of the Mn ferrites containing 30–38 atomic % Fe. It is found that non-conductors in which there is a large proportion of a conducting substances or in powders in which the individual particles (conductors) are surrounded by an insulating layer, have high dielectric losses at low frequencies but as the frequency increases these decrease rapidly; a decrease in the conductor content also has the same effect. The apparent dielectric constant is of the order of 50 times that of a pure non-conductor but it rapidly decreases with frequency. Since the Mn ferrrites exhibit identical properties with those of the mixtures, it is concluded that they are inhomogeneous in structure and consist of conducting particles insulated from each other by non-conducting layers. H. J. H. S.

2575. Dielectric Polarisatiop of *n*-Long Chain Ketone. A. Müller. *Roy. Soc., Proc.* 166*A*. *pp.* 316–324, *May* 19, 1938.—The present work is a continuation of a previous investigation [see Abstract 868 (1937)] on the dielectric polarisation of a long-chain ketone. The materal is, again a chain molecule carrying a dipole at its centre. The substiance instead of being allowed to expand freely, as in the previous experiments, is kept at constant volume, and the effect of temperature variation is now studied under these new conditions. The experiments show that the constraint imposed upon the system has a very marked effect on the dielectric polarisation. It follows from the observations that the rapid rise of the polarisation observed in the previous constant-pressure experiments is intimately connected with the similarly large expansion of the crystal lattice found with all long-chain substances. With regard to the theory of the cooperative effects shown by these substances, the present experiments prove that a variation of the boundary conditions has a large effect upon the behaviour of the substance. AUTHOR.

2576. Dielectric Constant of Carbon Disulphide at Low Temperatures. R. Guillien. *Comptes Rendus,* 206. *pp.* 1001–1002, *March* 28, 1938.—Measurements of the dielectric constant (k) of CS_2 over a temperature range of 20° C. to − 115·5° C. show that k increases almost linearly from 2·635 at 20° C. to 2·994 at − 110° C., after which there is a sharp increase on solidification to 3·250 at − 114·8° C. followed by a decrease. E. R.

2577. H.F. Dielectric Loss of Liquids. P. Wulff and H. Schwindt. *Zeits. f. phys. Chem.* 39. *Abt.B.* 3–4. *pp.* 275–313, 1938.—The apparatus used and the results obtained in measurements of dielectric loss in liquids, principally in the range 250 m. to 600 m. are described. The method used consists in replacing the test condenser in a resonant circuit by a combination of air condenser and series resistance. The voltage across the resonant circuit, as measured by a valve voltmeter, is made the same in the two cases by choice of a suitable resistance. Results are given for measurements at various temperatures on heptane, paraffin oil, benzene, ethyl alcohol, iso-amyl alcohol, propyl alcohol, toluene, dioxan, ether, tetralin, various fatty acids and various mixtures of them. In some case the loss measured is ascribed to conductivity, in others to dipoles. W. H. W.

2578. Initial Charging Current in an Anomalous Dielectric. B. Gross. *Zeits. f. Physik,* 108. 9–10. *pp.* 598–608, 1938.—The time dependence of the current in a capacity shows, apart from the time required to charge an ideal capacity under the influence of a given voltage, also a delay which depends on the nature of the dielectric. A method is developed in which the charging potential is applied to the capacity for a very short time by means of a Helmholtz pendulum, and the subsequent variation of potential can be measured. The measurements are carried out with a roll of telephone wire as capacity. It is found that upon shortening the interval during which the capacity is on charge, the initial value of the charging current for intervals $> 10^{-5}$ sec., increases without becoming constant. R. P.

See also Abstract 2355 and

1820B. H.F. Thermal Breakdown of Solid Dielectrics. E. Gailish.
1844B. Direct Measurement of H.F. Loss Conductance of Condenser. M. Boella.
1845B. Method of Measuring Small Capacitances at Power Frequency. C. Pistoia.

ELECTROCHEMISTRY.

***2579. Light High-Potential Battery. W. E. Ramsey.** *Frank. Inst., J.* 225. *pp.* 401–409, *April*, 1938.—An extremely light high-potential battery is described. The battery is constructed on conventional lines, but the usual zinc jacket is replaced by a single turn of very pure zinc wire, and the electrolyte is carried by a turn of blotting paper saturated with strong NH_4Cl solution, and held in contact with the depolarising mass by the zinc wire. The complete unit weights about 0·9 gm. and provides a voltage of 1·53 V as an average. The cells can be assembled in a mounting and are specially useful for aeronautical purposes, for which the battery was designed. The battery is suitable for laboratory uses as well, and has many advantages over existing types of high-potential batteries. F. J. B.

2580. Electrodeposition of Copper in Presence of Iron Salts. M. Geloso and P. Deschamps. *Comptes Rendus*, 206. *pp.* 1099–1102, *April* 4, 1938.—The electrolyte used contained per 130 cc., 10 cc. 7*N*–H_2SO_4, 5 cc. 5*N*–HNO_3, 235 mg. $CuSO_4$, 25 cc. of 0·831*N*–$Fe(NO_3)_3$. The variations in the amount of Cu deposited, due to alternations of electrolysis of the Cu salt, and re-solution of the Cu through its reducing action on the ferric salt, as affected by changes in temperature and agitation, were determined. Deposition of Cu is hindered or entirely stopped by rise in temperature and increased agitation. A current-potential curve is given showing the successive stages at which reduction of ferric to ferrous iron, deposition of Cu, and evolution of H_2 predominate. C. A. S.

2581. Electrolysis of Solutions of Protactinium. H. Emmanuel-Zavizziano and M. Haïssinsky. *Comptes Rendus*, 206. *pp.* 1102–1103, *April* 4, 1938.—When electrolysing a H_2SO_4 solution of Ti containing Pa with Pt kathode the Ti is deposited either as a white layer of hydroxide (or basic salt), or as a thin black layer according as there is increase in pH and c.d., or in concentration of NH_4F and agitation. The best yield of Pa in the white deposit is obtained with an unagitated solution of pH6 containing per cm³. 0·5–2 mg. TiO_2 and 20–40 mg. NH_4F with c.d. 5 mA/cm². The first 10% of TiO_2 then contains 50–70% of the Pa. In the black deposit there is little variation in the proportion of Pa as deposition proceeds. [See Abstract 2235 (1937).] C. A. S.

2582. Electrolysis of Molten Salts. P. Drossbach. *Zeits. f. Elektrochem.* 44. *pp.* 288–291, *May*, 1938.—The electrolysis is considered of (I) $SnCl_2$ at 460°, (II) $CdCl_2$ at 650° and (III) a mixture of 50% $CdCl_2$ + 50% KCl at 650° rising to 750°. The kathode current yields are respectively 88,

60·2 and 74·2%, and energy consumption 2·2, 2·6 and 2·7 kWh. In (I) no Cl_2 is evolved, $SnCl_4$ being formed. Determination of anode yield is recommended; this is affected, especially in (II) and (III), by the solubility of the metal, its diffusibility through the electrolyte, and its reaction velocity with Cl_2. The advantage of enclosing the electrodes, especially the anode, to hinder diffusion, etc., and consequent back reaction is stressed.
C. A. S.

2583. Potential of Cadmium in Cadmium Benzene-Sulphonate. M. Quintin. *Comptes Rendus*, 206. *pp*. 902–903, *March* 21, 1938.—The potential (E_{cd}) was determined by means of the cell | –Cd (amalgam 2 phases) | $Cd(PhSO_3)_2$, *c* | KCl, satd. | KCl, 0·1–*N* | Hg_2Cl_2, Hg + | for various concentrations (*c*, gm.mol./l). E_{cd} ($\times 10^4$) increases from 0·3857 to 0·4407 as *c* decreases from 0·08211 to 0·001, while E_0 (the normal potential) ($\times 10^4$) varies between 0·3550 and 0·3509. These results, and the fact that Debye and Hückel's law is not obeyed, indicate that considerable hydrolysis of the benzene sulphonate occurs at high dilution. C. A. S.

2584. Lanthanum Amalgam Electrode for Precise E.M.F. Measurements. W. G. Parks and R. W. Kingerley. *J. Phys. Chem.* 42. *pp*. 483–496, *April*, 1938.—It is definitely concluded that La amalgams are unsatisfactory for precise e.m.f. measurements.

2585. Potentials of Pt Electrodes in Photographic Developers. A. E. Cameron. *J. Phys. Chem.* 42. *pp*. 521–530, *April*, 1938.—The potentials of blank Pt electrodes in photographic developer solutions are found to be functions of the O_2 concentration as well as of the concentration of the reducing agent. The reducing agent and molecular O_2 take part in the electrode reaction upon opposite sides of the equilibrium. The most apparent effect of sodium sulphite is to destroy any reversible oxidation–reduction system which might otherwise mask the "oxygen" electrode potential. AUTHOR.

2586. Electrochemical Behaviour of Rhodium. Part V. G. Grube and H. Autenrieth. *Zeits. f. Elektrochem.* 44. *pp*. 296–299, *May*, 1938.—In HF and H_2SiF_6 solution electrolytic oxidation of Rh does not exceed the tetravalent stage. In solutions of Rh complexes, whether the Rh is in the kation or anion, *e.g.*, $[Rh(NH_3)_5Cl]Cl_2$, $[Rh(NH_3)_5Cl](ClO_4)_2$ or $K_3[Rh(CN)_6]$ it does not occur at all. The normal potential of the reaction $Rh^{III} + (+) \rightleftharpoons Rh^{IV}$, and $Rh^{IV} + 2(+) \rightleftharpoons Rh^{VI}$ are almost identical, and Rh^{IV}, if it exists, which is doubtful, is practically indistinguishable from $2Rh^{III} + Rh^{VI}$. Solutions containing highly oxidised Rh are unstable, evolving O, and are consequently strong oxiders. The oxidation potential of a HNO_3 solution containing $Rh^{III} + Rh^{VI}$ in equal amounts is 1·46 V, of one in $HClO_4$ 1·48. [For Part IV see Abstract 5450 (1937).] C. A. S.

2587. Normal Potential of Deuterium and the Ionic Equilibrium in Mixtures of H_2O and D_2O. G. Schwarzenbach. *Zeits. f. Elektrochem.* 44. *p*. 302, *May*, 1938.—Previous results are elaborated and discussed. It is concluded that the potential of the chain D_2 | DCl in D_2O | KCl in H_2O (satd.) | HCl in H_2O | H_2 is nearer the normal potential of D_2 than the chain D_2 | DCl in D_2O | AgCl Ag AgCl | HCl in H_2O | H_2. [See Abstract 3048 (1936).] C. A. S.

2588. Overvoltage and Mechanism of Electrolytic Hydrogen Evolution. K. Wirtz. *Zeits. f. Elektrochem.* 44. *pp*. 303–326, *May*, 1938.—This paper contains a survey of recent advances in this subject which are dealt with under the following sections: Definition of electrode potentials and overvoltage; methods of potential measurement; data from measurements of overvoltage; the Tafel theory; the theory of Volmer and Erdey-Grúz; consideration of the ζ-potential; theory of Gurney; minimum overvoltage for the formation of free atoms; importance of atomic adsorption; adsorption and reversibility in Gurney's theory; overvoltage in consequence of the retarded diffusion of H_2-molecules in the solution; classification of the velocity laws (forms of the Tafel equation); electrolytic separation of hydrogen isotopes; catalysis of exchange reactions and overvoltage. H. H. Ho.

2589. E.M.F. of Saturated Weston Standard Cells Containing D_2O. L. H. Brickwedde and G. W. Vinal. *Bureau of Standards, J. of Research*, 20. *pp.* 599–605, *May*, 1938.—Saturated Weston standard cells in which D_2O is substituted for some or all of the normal water may be expected to have e.m.f.s. slightly different from those made with normal water. A study has been made of the characteristics of 12 cells, prepared with identical materials, except for the isotopic composition of the water. The initial samples of water contained 0·018 (normal water), 1·036, 3·121, and 6·848 mole % of D_2O. The ratios of moles of D_2O to H_2O in the finished cells were less than in the original samples, because of dilution by the water of crystallisation of the cadmium sulphate. The constancy of the e.m.f. of each of the 12 cells is shown by the small average deviation of single observations, extending over several months, from the respective mean values. In no case did it exceed 0·6 μV. The decrease in e.m.f. as a result of using the D_2O amounted to 2·9 μV/mole%. No significant difference was found in the temperature coefficient for the various D_2O concentrations. Hysteresis measurements indicate a slight superiority for the cells containing added D_2O. Measurements of the internal resistance of the cells at 20 and 28° C. indicate a ratio of $R_{20}/R_{28} = 1{\cdot}24$. The cells containing D_2O are fully as reproducible and constant as those made with normal water, and in some respects they may be superior. AUTHORS.

See also Abstracts 2231, 2465.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2590. Notion of Corpuscle. Application to Heavy Electrons. J. L. Destouches. *Comptes Rendus*, 206. *pp.* 1281–1284, *May* 2, 1938.—Precision is given to the concept of a corpuscule by defining it as a physical system represented by a single point in the physical space of an observer; its properties are defined by the corpuscle's fundamental ring. It is also characterised by the constancy of certain magnitudes. A corpuscle then is defined by the possible values of its spin [two types only of simple spin, *viz.* $(-1, 0, +1)$ and $(-\frac{1}{2}, +\frac{1}{2})$ are possible], its mass and charge. Neutrons and protons are not corpuscles of simple spin; they are necessarily complexities. Heavy electrons may possibly have either type of spin and will have very different properties accordingly. Sufficient knowledge of heavy electrons is not available to decide between the two hypotheses. J. S. G. T.

***2591. Improved Method for the Determination of the Specific Charge of β-Particles; Specific Charge of Disintegration Electrons from RaE. C. T. Zahn and A. H. Spees.** *Phys. Rev.* 53. *pp.* 357–373, *March* 1, 1938.—Detailed investigation is made of the behaviour of electrons moving in crossed electric and magnetic fields and an apparatus is described which is a modification of the type used by Bucherer and Neumann. The positions of source and detector are effectively interchanged and the photographic plate is replaced by a Geiger counter. The effect of scattering and the importance of high resolution are examined very thoroughly and the possibilities of the method for very high energy electrons are discussed. The apparatus was used to determine the specific charge of the disintegration electrons from RaE. No special aim was made towards accurate *absolute* values to more than 2% but the limitations are mainly in the calibration of the electromagnetic and geometrical constants. The final corrected value for *e/m* agreed with the special theory of relativity to within 1·5% and the possibility, suggested elsewhere, that the disintegration electrons from RaE might be " heavy " electrons is considered to be quite untenable. [See following Abstract.] F. C. C.

2592. Critical Analysis of the Classical Experiments on the Relativistic Variation of Electron Mass. C. T. Zahn and A. H. Spees. *Phys. Rev.* 53. *pp.* 511–521, *April* 1, 1938.—Mathematical analysis is continued [see preceding Abstract] of the Bucherer-Neumann experiments on relativistic variation of electron mass. From considerations of scattering, limits of resolution and so on, it is concluded that these experiments showed little beyond the qualitative demonstration of the increase of mass with velocity. It is contended that no satisfactory quantitative test has yet been made to distinguish between Lorentz and Abraham electrons at velocities greater than about 0·5 that of light. F. C. C.

2593. Heavy Electron. J. L. Destouches. *Comptes Rendus,* 206. *pp.* 1095–1097, *April* 4, 1938.—The author concludes from his " structural theory " of the ultimate particles of matter combined with the observation of the penetration of cosmic rays in lead, that the heavy electron has a mass 1/8 that of the proton. It is also suggested that the spin has the values ± 1. G. C. McV.

2594. Energy-Range Relations for Deuterons, Protons and α-Particles. F. T. Rogers, Jr. and M. M. Rogers. *Phys. Rev.* 53. *pp.* 713–714, *May* 1, 1938.—The complete deuteron, proton and α-particle energy-range relations as given by Livingston and Bethe and as subsequently revised by Bethe to include the latest data, are presented as a set of eleven equations. Given the range of a known particle, the corresponding kinetic energy of the particle can be computed easily and quickly from these equations. AUTHORS.

2595. Experiments on Magnetic Properties of Free Neutrons. O. R. Frisch, H. v. Halban, Jr., and J. Koch. *Phys. Rev.,* 53. *pp.* 719–726, *May* 1, 1938.—The behaviour of partly polarised beams of slow neutrons as regards their precession on passing through homogeneous magnetic fields has been investigated. Fron the experiments it is concluded that the neutron has a magnetic moment not far from 2 × 1/1840 Bohr magneton and that the sign is negative. Further, the precession of neutrons inside magnetised iron was investigated ; it was found that the field accounting for the observed rate of precession is more than 100 times the actual field strength H and actually of the order of magnitude of the magnetic induction B. AUTHORS.

2596. Nuclear Collisions. L. Goldstein. *J. de Physique et le Radium,* 9. *pp.* 96–104, *March,* 1938.—The statistical model of an intranuclear gas, composed of protons and neutrons, appears to be well adapted to the study of the disappearance of nuclear levels activated by the emission of heavy particles. This process of disappearance corresponds to the second limiting step in nuclear collision phenomena. In the limiting case it appears justifiable to consider separately the two steps of the dispersive collision, in which case the second step is described approximately as a sort of effect of Richardson evaporation of heavy particles; the nucleus activated during the first stage of the collision being able to emit a heavy particle if the activation is sufficiently energetic. One is thus led to a Maxwellian type of law of distribution of the emitted heavy particles. The probability of total emission of a particle, in this statistical model, for a state of activation of the same energy, decreases very much with the atomic number of the nucleus. For the same nucleus, this total probability increases rapidly with the energy of excitation. Within the approximation of the present model, the disappearance of nuclear levels highly activated by the emission of two particles is also investigated. From a discussion of nuclear levels with large energy, it appears that levels with nuclear energies group themselves into bands separated by the critical energies. G. O. B.

2597. Multiple Scattering of Electrons. H. A. Bethe, M. E. Rose and L. P. Smith. *Am. Phil. Soc., Proc.* 78. 4. *pp.* 573–585, 1938.—The multiple scattering of electrons is calculated in terms of the well-known cross-section for single scattering. The transmission of a collimated beam through a plane parallel plate is treated, neglecting energy loss; the transmitted intensity is found to be inversely proportional to the thickness of the plate for large thicknesses. Under certain conditions (nearly random distribution of velocities) the motion of the electrons can be treated as a diffusion problem, and their energy loss taken into consideration; several applications are given. The absorption of fast electrons due to energy loss and scattering is discussed quantitatively. These considerations are applied to the determination of γ-ray energies from the absorption of their secondary electrons and very good agreement with experimental data is obtained. AUTHORS.

2598. Properties of a Homogeneous Electron Beam after Transmission through a Thin Foil. J. J. Trillat and A. Hautot. *Ann. d. Physik*, 31. 7. *pp.* 583–584, *April*, 1938.—A reply is given to a criticism in a paper on the same subject by F. Kirchner [see Abstract 858 (1938)]. It is pointed out that the discrepancies in the results are not inconsistent, for Kirchner used films of appreciable thickness whereas the authors' results were confined to foils of thickness not exceeding 1μ. Some small differences noted by Kirchner are attributed to experimental error which is of the order of 0·5% in each case. H. J. H. S.

2599. Theory of Electron Diffraction and the Kikuchi Envelope. E. Lamla. *Ann. d. Physik*, 32. 1–2. *pp.* 178–189, *May*, 1938.—Calculations are carried out on the dynamical theory formulated by Laue [see Abstract 2689 (1937)], whereby the infinite number of homogeneous linear equations is reduced to a series. The equations explain the satisfactory results obtained when the Kikuchi envelope is applied to the incoherent scattering of electrons by the atoms of a surface layer. F. C. C.

2600. Creation of Electron Pairs by Nuclear Capture of Neutrons. H. S. W. Massey. *Roy. Irish Acad., Proc.* 44*A*. 6. *pp.* 77–85, *Jan.*, 1938.—Calculation is made of the probability of formation of electron pairs produced by a triple collision between nucleus, neutron and an impalpable electron in a state of negative kinetic energy. Both allowed and forbidden nuclear transitions are considered. The results are evaluated numerically and the effective cross-section for pair formation by slow neutrons is about 10^{-32} cm². The effect is too small to be detected in the present state of experimental technique. F. C. C.

2601. Diffusion of Neutrons of Uniform Speed through Protons. B. Pontecorvo. *Comptes Rendus*, 206. *pp.* 1003–1005, *March* 28, 1938.—The author measures the diffusion of neutrons of uniform velocity of 225 ekV through protons with the aim of confirming Bethe's formula for the cross-section σ of the interaction between neutrons and protons [see Abstract 1370 (1938)]. The neutrons (photoneutrons produced by the disintegration of D under the irradiation of γ-rays) pass through a block of paraffin; their transmission is measured by a Dy-detector. After applying corrections for those neutrons which enter the detector after having suffered a collision and for the interaction between the C nuclei and neutrons, the mean free path of the neutrons in the paraffin is found to be $\lambda = 1\cdot3$ cm. and the cross-section $\sigma = 8\cdot1 \times 10^{-24}$ cm². The accuracy is 15%. From Bethe's formula the value 90000 eV is calculated for $|E_1|$. The theoretical values are $\sigma = 7\cdot4 \times 10^{-24}$ cm². and $|E_1| =$ 120,000 eV, in good agreement with the experimental results. L. K.

2602. Energy and Intensity of Photoneutrons from Beryllium and from Deuterons. H. v. Halban, Jr. *Comptes Rendus*, 206. *pp.* 1170–1172, *April* 11, 1938.—The distribution of density of thermal neutrons produced by the slowing down of neutrons produced from a source of Ra or MsTh and Be or ${}^2_1$D, was determined, using a screen of Dy as detector. To produce photoneutrons in D γ-rays of $\nless 2\cdot64$ eMV are necessary, and the cross-sections for photo-nuclear effect for such rays with Be and D are respectively $3\cdot1 \pm 0\cdot4$ and $10 \pm 0\cdot8 \times 10^{-28}$ cm². The curves obtained with Ra-D and RdTh-D are similar, which shows that Ra emits γ-rays of more than 2·19 eMV, but the yields are very different being approximately 1 : 20. This gives a method of determining the amounts of Ra and RdTh in a MsTh source without chemical treatment. C. A. S.

2603. Slow Neutrons Transmitted by Cadmium. C. H. Westcott and L. Sosnowski. *Cambridge Phil. Soc.*, *Proc.* 34. *pp.* 272–281, *April*, 1938.—The paper is concerned with the influence on the effects produced by slow neutrons, of the temperature of the medium in which they are slowed down, attention being focused on those neutrons which pass freely through Cd. Results obtained by Arsenjewa-Heil, Heil and Westcott (*Nature*, 138. *p.* 462, 1936) had appeared to show that the groups A and B responsible for activating silver had energies low enough to be affected by temperature. In the present work, a confirmation of the change for group B has been obtained, and a similar effect has been observed with a boron detector. It is suggested that the explanation of the results is that Cd transmits neutrons of energies down to about 0·2 eV., and that " group B " is inhomogeneous. During the course of the work, a study of the conditions under which reproducible results could be obtained was undertaken. AUTHORS.

2604. Dependence of the Coefficient of Secondary Emission on Angle of Incidence of the Primary Beam. S. J. Lukjanov *Phys. Zeits. d. Sowjetunion*, 13. 1. *pp.* 123–126, 1938. *In English.*—The approximate formula, $\log\sigma = \log B - 2/3\,\gamma\cos\phi$ is applied to many substances, where σ is the coefficient of secondary emission of electrons, ϕ the angle of incidence of the primary beam and B and γ constants. The value of the parameter γ varies for different metals, being larger for lighter ones. Using the Thomson-Whiddington formula $\gamma = \beta V_0^2/a$ where V_0 is the initial energy of the primary electrons, the theoretical value of γ is calculated from known values of β and α. For Ni this is seen to be in fair agreement with values obtained by consideration of the angle of incidence.

H. M. B.

*2605. **Theoretical Resolving Power of the Electron Microscope. R. Rebsch.** *Ann. d. Physik*, 31. 6. *pp*. 551–560, *March*, 1938.—It is shown that the resolving power of a high power electron optical system depends on the wave-length of the electron stream and on the focal length of the objective lens. In the absence of space-charge, the ultimate resolving power is between 10 and 100 wave-lengths. It is emphasised that it is not justifiable to obtain the resolving power by means of the Abbé formula.

H. J. H. S.

*2606. **Progress in Construction and Performance of Ultramicroscopes. B. v. Borries and E. Ruska.** *Wiss. Veröff. a. d. Siemens-Werken*, 17. 1. *pp*. 99–106, 1938.—A description is given of a new electron microscope which embodies many improvements on the previous model of Ruska. With a tube potential of 80 kV, a focal length of 5·4 mm. is obtained for the objective coil and 1·0 mm. for the projector coil; with an image distance of 400 mm. the corresponding magnifications are 75 and 400, resulting in a total of 30,000 for the two stages. The aperture of the objective is much smaller than in the optical case and under optimum conditions it does not exceed 0·1. The performance of this instrument is illustrated by a series of photographs of colloidal Ag and Au supported by a thin collodion film; the magnifications range from 11000 to 19000 (including enlargement from the original negatives). A photograph of *staphylococcus aureus* at a magnification of 20,400, part of which is enlarged to 100,000 times, shows that the order of the resolving power is 0·01μ. [See following Abstract.]

H. J. H. S.

2607. Ultramicroscopic Photographs of Bacteria. B. v. Borries, E. Ruska and H. Ruska. *Wiss. Veröff. a. d. Siemens-Werken*, 17. 1. *pp*. 107–111, 1938.—Photographs of a number of common bacilli are described. Comparisons with ordinary optical photographs show the superiority of the electron microscope method, for the resolving power of the electron optical system is sufficient to reveal detail within the bacilli which it is impossible to obtain by ordinary optical means. [See preceding Abstract.]

H. J. H. S.

2608. "Phase Focusing" in Rapidly Fluctuating Electric Fields. E. Brüche and A. Recknagel. *Zeits. f. Physik*, 108. 7–8. *pp*. 459–482, 1938.—"Phase focusing" is obtained by passing a beam of electrons through a h.f. electric field. Small "trains" of electrons of similar velocity, after passing through the field, are brought to a focus at a point behind the field at a certain instant; the space-time relations may be deduced from electron-optical considerations. Electrons which, at the same instant, are moving in the same direction but at somewhat different velocities are also brought to a focus. The refractive index in ordinary geometrical electron optics is related to the velocity of the electron but in phase focusing it is determined by the 3rd power of the velocity. Any radially symmetrical arrangement (electron lens) to which a h.f. potential is applied may be used for phase focusing but such focusing is of a much lower degree for second-order errors are already present. Phase focusing corresponds to direction focusing in a transverse magnetic field. A number of similarities between ordinary electron optical focusing and phase focusing are pointed out.

H. J. H. S.

***2609. Simultaneous Recording of Two Phenomena by Means of the Braun Tube. K. Sedlmayr.** *Assoc. Suisse Élect., Bull.* 29. *pp.* 189–194, *April* 29, 1938.—A description is given of a simple experimental arrangement by means of which variations in the length and voltage of an arc are simultaneously recorded on a photographic film. A slit image of the arc is projected on the screen of a kathode-ray tube whilst the p.d. across the arc is applied to the deflecting plates. The camera lens thus projects two images, one of the arc-length and the other of the arc-voltage, on the film. A theoretical treatment of the optical arrangement is given and a number of specimen records are reproduced.

A. B. W.

See also Abstracts 2283, 2391, 2393, 2394, 2424, 2488, 2548, 2551, 2552, 2619.

ELECTROSTATICS.

2610. Potentials in Curved Surfaces. G. R. Stibitz. *Phil. Mag.* 25. *pp.* 783–785, *May*, 1938.—The differential equation in curvilinear coordinates (u, v), satisfied by the two-dimensional electric potentials (V) in isotropic surfaces defined by $ds^2 = g_{11}du^2 + 2\,g_{12}\;du\,dv + g_{22}\,dv^2$ is derived in the form:

$$\frac{\partial}{\partial u}\left[\frac{1}{\rho\sqrt{g}}\left(g_{22}\frac{\partial V}{\partial u} + g_{12}\frac{\partial V}{\partial v}\right)\right] + \frac{\partial}{\partial v}\left[\frac{1}{\rho\sqrt{g}}\left(g_{11}\frac{\partial V}{\partial v} + g_{12}\frac{\partial V}{\partial u}\right)\right] = 0,$$

ρ denoting the resistivity of the surface. If u and v are isometric coordinates and ρ is constant, the equation reduces to $\dfrac{\partial^2 V}{\partial u^2} + \dfrac{\partial^2 V}{\partial v^2} = 0.$

J. S. G. T.

2611. Voltaic E.M.F. in Alloys. Part I. O. Scarpa. Part II. O. Scarpa with C. Rossi. *Accad. Lincei, Atti.* 27. *pp.* 6–11, *Jan.*, 9, *and pp.* 57–62, *Feb.* 6, 1938.—The pile consists of two flat discs of the reference metal, approximately 7 cm. in dia., emeried and varnished with rubber solution, arranged as a variable condenser in the classical manner. A disc of the alloy under test, dried out for 48 hr., is placed between them, the atmosphere being maintained dry during test, by means of $CaCl_2$. The e.m.f. is measured by a Kelvin bridge method. Cu-Ni alloys (continuous solid solutions) give a smooth curve, almost linear, when e.m.f. is plotted against percentage of Ni; for pure Ni the value is + 0·387 V. In the Sn-Zn alloys (eutectiferous) addition of Zn in small quantities to Sn rapidly inhibits the voltaic effect, the e.m.f. being − 0·40 for Sn, − 0·07 for 4% Zn, − 0·06 for 8% Zn, − 0·04 for 15% Zn; in this series 0·02 V is allowed for the effect of varnishing. The voltaic e.m.f. against Cu is determined for six Cu-Zn alloys. From 0·73 V for Zn, it falls to 0·71 at 4% Cu, rises to a peak of 0·79 at 10% Cu and afterwards drops smoothly. Thermoelectric power shows a similar variation which the authors attribute to the ϵ solid solution being based on an intermetallic compound $CuZn_6$ and containing 86% Zn.

D. R. H.

***2612. Possiblity of Improving Electrometers. E. Perucca.** *Zeits. f. Physik*, 108. 9–10. *pp.* 635–639, 1938.—The construction of an extremely sensitive, robust and low capacity electrometer of the duant type is described. The high sensitivity is obtained by means of a paddle shaped quadrant and a delicate suspension which presents some unique features. Suggestions are made for improving the sensitivity and mechanical behaviour of the usual type of electrometer. [See also Abstract 867 (1936).]

H. J. H. S.

See also Abstract 2521.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2613. Peculiarities of Hall Effect in Zn Single Crystals. M. M. Noskov. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 127–129, 1938. *In English.*—The Hall effect is measured in fields of $13 \cdot 5$ kG for four specimens of Zn single crystals in which the basal plane of the hexagonal lattice forms different angles with the length of the plate and is parallel to the rotation axis. The results are in good agreement with theory. It is concluded that the Hall effect in Zn seems to be most sensitive to the crystal structure. [See following Abstract]. R. L.

2614. Change of Resistance of Zn Single Crystals in a Magnetic Field. B. G. Lasarew and M. M. Noskov. *Phys. Zeits. d. Sowjetunion,* 13. 1. *pp.* 130–132, 1938. *In English.*—Measurements have been made of single crystal wires of pure Zn in magnetic fields of 0–14.1 kG at liquid-N_2 and room-temperatures. The "rotation diagrams" round the axis perpendicular to the current and to the magnetic field and parallel to the basal plane of the hexagonal lattice of Zn have been obtained. The field dependence at the most characteristic points of the diagrams has been investigated. A Bibliography is appended. [See preceding Abstract.] R. L.

2615. Influence of Transverse Magnetic Fields on Electrical and Thermal Conductivity of Pure Metals at Low Temperatures. E. Grüneisen and H. Adenstedt. *Ann. d. Physik,* 31. 8. *pp.* 714–744, *April,* 1938.—Determinations of electrical resistance ρ and thermal resistance w are carried out on very pure samples of Cu, Ag, Pt, W and Be, some in the form of single crystals. The alterations of ρ and w due to magnetic fields up to 12 kOe at -253° C. are determined. For Be measurements are also made at -195° C. For a given field the changes of ρ are of the same order for Cu, Ag and Pt, that for w is 40–50 times greater and that for Be (parallel to hexagonal axis) is about 500 times greater. The effect shows marked anisotropy. The alterations of w are similar but not so great and the anisotropy is less pronounced. [See following Abstract. L. A. W.

2616. Effect of Transverse Magnetic Field on Thermal Resistance of Pure Metals. E. Grüneisen. *Ann. d. Physik,* 32. 1–2. *pp.* 219–224, *May,* 1938.—Experimental results previously published [see preceding Abstract] are cited in a consideration as to whether the theory of Kohler as to the effect of a magnetic field on electrical resistance [see following Abstract] is applicable to the corresponding effect on thermal resistance. It is concluded that the relationship between the two effects is too complicated for the theory to be applied directly to the thermal resistance. The observed fact that a transverse magnetic field has a greater influence on the electrical resistance than on the thermal resistance is considered to be due firstly to the magnetic field acting similarly to a lattice deformation and secondly to the effect of lattice conduction. L. A. W.

2617. Influence of Magnetic Fields on Electrical Resistance of Pure Metals. M. Kohler. *Ann. d. Physik,* 32. 1–2. *pp.* 211–218, *May,* 1938.—On the assumption of an isotropic collisional time dependent upon temperature and degree of purity, but without special assumption as to eigenvalue distribution of the electrons, a theoretical relation is deduced between the dependence of resistance upon magnetic field strength and the dependence upon temperature and degree of purity. Both longitudinal and transverse effects are considered. The deductions are compared with experimental data and found to be valid in a number of cases. [See preceding Abstract]. L. A. W.

MAGNETISM AND ELECTROMAGNETISM.

2618. Principle of the Conservation of Electricity. A. Boutaric. *J. de Physique et le Radium,* 9. *pp.* 67–68, *Feb.,* 1938.—The principles of conservation of mass and energy do not apply, in their original form, to individual processes of intra-atomic order. Conservation of electricity appears to be universally valid. The principle is illustrated by examples of atomic and intra-atomic order. W. S. S.

2619. Magnetism and the Vibratory Electron. E. T. Jones. *Phil. Mag.* 25. *pp.* 682–693, *April,* 1938.—A vibrational electron theory has been developed in previous papers [see Abstract 5688 (1937)], in which it has been shown that in a great many electrostatic systems the mutual energy of the pairs and the electrostatic forces between them can be accounted for if the electrons form systems of coupled vibrators, difference of phase of their vibrations corresponding to difference of sign of their charges. The theory is now applied to magnetism; and it is shown by several examples that magnetic energy due to electrons in translational motion can be explained on the vibratory electron theory. An isolated electron at rest, or in motion, has neither electrostatic nor magnetic energy, but it acquires one or both when its frequency is changed by the coupling effect of other electrons, the amount of energy being equal to the product of the frequency and Planck's constant. An electromagnetic field contains only one kind of energy, vibrational energy, magnetic and electrical energy being merely changes in this. C. J. B. C.

2620. Ferromagnetism and Structure of Manganese Ferrites. A. Kussmann and H. Nitka. *Phys. Zeits.* 39. *pp.* 208–212, *March* 15, 1938. *From the Reichsanstalt.*—A magnetic and X-ray examination of 12 samples of Mn ferrites shows that the ferromagnetism is determined by the solid solution phase with a cubic face-centred lattice which extends at 1300° C. as far as Fe_2O_3 and which, on quenching, is unstable at room-temperature. At temperatures lower than 1300° C. and on the Fe side, decomposition and transformation occur into the rhombohedral phase which is not ferromagnetic. The relation between magnetisation and crystal structure is thus similar to that of pure Fe_2O_3. On the Mn side, the ferromagnetism diminishes at a rate which depends on the transition from the cubic face-centred to the tetragonal lattice. H. J. H. S.

2621. Recent Advances in Magneto-Chemistry. S. S. Bhatnagar. *Science and Culture,* 3. *pp.* 466–475, *March,* 1938.—A review. W. R. A.

2622. Magnetic Study of Dehydration of Crystallised Cupric Hydroxide. L. Chaumeton. *Comptes Rendus,* 206. *pp.* 1104–1106, *April* 4, 1938.—Blue crystallised $Cu(OH)_2$ was dehydrated (1) gradually by prolonged heating at 110°, and (2) rapidly by heating quickly to 150–160°. In both cases the magnetic susceptibility was plotted against H_2O content. In (1) a linear relation is shown with no indication of the formation of any intermediate compound. In (2) a curve is given indicating that the dehydrated (or partially dehydrated) oxides thus produced retain H_2O in excess of that of constitution. C. A. S.

2623. Paramagnetism of Organic Cupri-tetrachlorides and Cupri-trichlorides. J. Amiel. *Comptes Rendus,* 206. *pp.* 1113–1115, *April* 4, 1938.—Using a Curie-Cheneveau balance the magnetic susceptibilities of a number of paramagnetic complexes formed between $CuCl_2$ and organic bases have been measured. After allowing for the diamagnetism of Cu, the Cl atoms, and the organic part of the molecule the susceptibility of the Cu atom is deduced. For all the cupri-tetrachlorides, except the complex with diethylamine, the value for the atomic susceptibility is practically constant. Cupri-trichlorides of five bases have also been examined. All measurements were carried out at 20°. W. R. A.

2624. Diamagnetic Susceptibility of Bismuth. M. Blackman. *Roy. Soc., Proc.* 166*A*. *pp.* 1–15, *May* 4, 1938.—An extension is made of the existing theory of the marked variation of the susceptibility of bismuth with field strength at low temperatures (known as the de Haas-van Alphen effect). The object of the investigation is to explain the finer features of the experiments, to account for the order of magnitude of the effect and for the dependence on the orientation of the binary axes. The extension consists in assuming a more general form for the relevant part of the surface of constant energy of the electrons. It is found possible to account for all the features of the susceptibility curves and also to fit the experimental curves fairly well. For this purpose one has to assume that the motion of the electrons is violently anisotropic and that only a small fraction of the conduction electrons contribute to the de Haas-van Alphen effect. AUTHOR.

***2625. Direct Reading Apparatus for Measurement of Magnetic Field. R. Servant and B. Tsaï.** *Comptes Rendus*, 206. *pp.* 1172–1174, *April* 11, 1938.—The principle of the apparatus is that a movable frame round which a wire carrying a current I, is wound, placed in a field H, is turned through an angle depending on HI, and that with I constant H can be measured. The frame is small and the wire thin, it is placed at the end of a rod 30 cm. long, and both it and the frame (with 500 turns of wire) only 6 mm. across, so that it can be placed between the poles of a magnet. At the other end is a dial with needle connected with the frame so as to measure H. The error $< 1\%$, and the range of H measurable is greater the smaller I. C. A. S.

See also Abstract 2275 and

1839B. Variation in H.F. Resistance and Permeability of Ferromagnetic Materials due to a Superimposed Magnetic Field. J. S. Webb.

1875B. Magnetic Dispersion of Parallel Conductors between Screens of Infinite Permeability. J. Kučera.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***2626. Mechanical Lag-Screen Oscillograph. F. E. Hoecker and A. G. Asher.** *Rev. Sci. Instruments*, 9. *pp.* 148–150, *May*, 1938.—The article describes an apparatus which may be used for the study of l.f. or non-cyclic wave forms. The instrument comprises a short-period suspended magnet galvanometer from the mirror of which a beam of light is reflected to a moving phosphorescent screen in the form of a continuous belt. The wave form appears as a bright line on a non-luminous background and remains easily visible for approximately 1 min. when observed in a dark room. The instrument is especially suitable for the study of electrocardiac impulses. AUTHORS.

***2627. U.V. Measurements of Natural and Artificial Sources of Radiation with the U.V. Dosimeter. W. Frankenburger and H. Hammerschmid.** *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 88–110, 1938.—The u.v. dosimeter, a pocket instrument for measuring the intensities of the therapeutically erythemogenic u.v. rays (range 315–250$\mu\mu$) is described in its principle and applicability. The following questions are treated in detail, (1) the reproducibility of the absolute values, measured with different instruments for the same u.v. intensities, and (2) the temperature coefficient of the dosimeter in measuring the u.v. emission of sunlight (sky light) and of artificial u.v. light sources. By use of quartz glass for the "test tube" all dosimeters give readings in agreement, but for artificial sources of u.v. a shielding tube to weaken the intensity of rays below $290\mu\mu$ is required. Temperature coefficients for sunlight and skylight are calculated for use in determining intensities of u.v. emission. The causes for the temperature coefficient are given. R. S. R.

***2628. Tests of Quartz Test Tubes of the Bioclimatic U.V. Dosimeter. L. W. Pollak and F. Fuchs.** *Gerlands Beitr. z. Geophys.* 53. 1-3. *pp.* 148–154, 1938.—The quartz test tubes of the bioclimatic u.v. dosimeter were compared in daylight and direct sunlight with the help of the authors' perfected electric light u.v. colorimeter. This method shows that the quartz tubes filled with the new standardised test solution, after exclusion of easily recognised stray effects, agree well with one another. The quartz tubes, especially the most recent, represent a test element easily reproducible. For the tubes tested, the deviations are constant and below ± 5% and thus the reference to a normal test tube appears guaranteed. No influence of the spectral composition of daylight or sunlight upon the deviations could be observed. [See Abstract 3274 (1937).] R. S. R.

2629. Sublethal Effects of Long Wave-Length Ultra-Violet. A. C. Giese. *Science,* 87. *pp.* 326–327, *April* 8, 1938.—Reference is made to previous experiments with u.v. light of wave-length 3130 and 3660 Å of effects produced in respect to cleavage of sea urchins' eggs (*Strongylocentrotus purpuratus*). Lethal effects were not found but the possibility of sublethal retardment of development arose. The author describes further investigations in this direction and shows that radiation of 3130 Å, whilst failing to produce a lethal effect, causes retardation of cell development, and radiation of 3660 Å has no lethal or retardation effect. B. J. L.

2630. Spatial Distribution of Radiation from a Supervoltage X-Ray Tube. Part II. K. E. Corrigan, B. Cassen and H. S. Hayden. *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 634–640, *April,* 1938.—Radiation from a 500-kV X-ray tube is distributed in space asymmetrically, the radiation of higher quality predominating in a forward direction. With thin filters a difference of the order of effective voltage of 100 kV may exist in different directions, with resulting variations of composition of the beam in respect to quality of radiation. This has been demonstrated by the epilation effect upon the skin of rabbits. The spatial distribution of irradiation is a function of the tube voltage and may serve as a sensitive measurement of "effective voltage." [For Part I see Abstract 4216 (1927).] B. J. L.

***2631. Model for a Radium Beam Unit for Measuring Dosage and Planning Treatments. L. G. Grimmett.** *Brit. J. of Radiology,* 11. *pp.* 271–272, *April,* 1938.—A replica of the original Ra beam unit [see Abstract 1845 (1937)] has been constructed in teak with all the essential movements of the original unit. It has been provided with a metal band for the directional caliper to run on and a teak eccentric capable of rotating like the eccentric Pb shield on the original. In this way the patient may be set up for treatment and the dosage that will be delivered to various points in the tissues may be estimated, while the disposition of the ports of entry and the time of treatment through each port may be arranged to the best advantage. This use of the wooden model of the unit avoids the loss of treatment time consequent upon the actual Ra unit being out of action 1–2 hr. daily. T. A. C.

2632. Dosage Chart for Interstitial Radium Element Needles. L. A. Pomeroy. *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 590–591, *April,* 1938.—Considering a tumour as a sphere, or a combination of spheres, tabular data are given showing the time required for the administration of an erythema dose to a sphere or spheres, with given quantities of Ra element in Pt needles. B. J. L.

2633. Dosage System for Interstitial Radium Therapy. Part II. H. M. Parker. *Brit. J. of Radiology,* 11. *pp.* 313–340, *May,* 1938.—Part II is concerned with the physical basis of the dosage rules given in Part I [see Abstract 2187 (1938)]. The guiding principles for the manipulation of single- and multiple-plane implants are derived from previous results relating to surface applicators. The foundation of the more general volume dosage lies in a study of the radiation fields created by distributions of a hypothetical radioactive fluid throughout the volume considered. The treatment has been restricted to cases in which two regions of different fluid density, the so-called rind and core, are permitted. The radiation fields have been evaluated for the sphere, circular and elliptic cylinders, ellipsoids and cuboids (rectangular parallelepipeds). The mean dosage-rate within solids of the same volume and radium content is independent of the shape, except for a small correction factor determined by the elongation. Dosage is given by the formula milligramme-hours per 1000 $\mathrm{r} = 21\cdot57 \times (\mathrm{Volume})^{\frac{2}{3}} \times e^{0\cdot07\,(\mathrm{Elongation}-1)}$. The modifications introduced into dosage and distribution by the substitution of actual radium needles for the fluid are described. AUTHOR.

2634. Relative Action of Neutrons and X-Rays on Closely Related Tissues. R. E. Zirkle and I. Lampe. *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 613–627, *April,* 1938.—The biological effects of neutron and X-ray irradiation have been studied in respect to wheat seedlings and drosophila eggs, the dosage in respect to X-rays being measured in terms of " r " units and of the neutron radiation in terms of an arbitrary ionisation unit (n-unit), the relative action being expressed as an X/N ratio of the biological effect produced. If the X/N ratios for two tissues were not equal, then the relative action of the two radiations were quantitatively different for the two tissues. This ratio differed in respect to the age of the drosophila eggs and whether the root or the shoot of the seedling was the subject of investigation. It is suggested that use of neutrons in radiotherapy may be more selective than is the case with X-rays. The relative effectiveness of neutrons and X-rays has been determined, in favour of neutrons, apparently co-related with the closer spacing of the ions in the tracts of the secondary ionising particles. The neutron irradiation was obtained by use of the cyclotron apparatus installed in the Department of Physics in the University of Michigan, employing a pure Be target. B. J. L.

***2635. Laminagraph and Its Variations. J. Kieffer.** *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 497–513, *April,* 1938.—The author's investigations date from 1928, but until 1936 he was unable to apply his apparatus practically. The theoretical conceptions of accentuation of parts of the body lying below the skin radiographically (for which the author proposes the name of laminagraphy as preferable to planigrapy and other names) are discussed and his apparatus described, with test radiographs for various movements of the X-ray tube. As a result of his investigations a circular or spiral motion of the tube is advocated to eliminate superimposed shadows. The applications are discussed in respect to diagnostic and therapeutic procedures. B. J. L.

***2636. Large Quartz Monochromator for Biophysical Research. F. M. Uber and S. Jacobsohn.** *Rev. Sci. Instruments,* 9. *pp.* 150–152, *May,* 1938.—Monochromatic irradiation studies of biological objects usually require a large slit area, high intensity, comparable irradiation conditions at all wave-lengths, and frequently some provision for treating on a horizontal surface. The present instrument provides for the simultaneous irradiation of 17 different samples, each covering 100 mm^2. of a horizontal surface with the exception of two which cover 75mm^2. each, each sample being exposed to a single wave-length of the Hg arc spectrum. The 17 wave-lengths are as follows: 3655, 3341, 3131, 3022, 2967, 2925, 2894, 2804, 2752, 2699, 2652, 2576, 2536, 2483, 2399, 2378 and 2352 Å. The straight spectral lines are 2 × 50 mm. The optical system consists of two 60° crystal quartz prisms, Cornu type, 51 mm. high and 85 mm. length of face; collimator and camera lenses have 70 mm. aperture and 418 mm. focal length. Exchangeable with the special holder for the biological materials are two other attachments: a photographic film holder and a calibrated traversing slit mechanism designed to carry a thermopile or a photo-cell. The instrument can be used in either a vertical or a horizontal position. AUTHORS.

2637. Secondary Radiation Intensity as a Function of Certain Geometrical Variables. H. E. Seemann. *Am. J. of Roentgenology and Radium Therapy,* 39. *pp.* 628–633, *April,* 1938.—Secondary irradiation from filters or diaphragms modifies the intensities of beams of radiation and it is therefore necessary to distinguish the effects from primary and secondary radiation. Making certain assumptions the problem can be treated geometrically given a fixed source and receiver. The question is considered when the position of a fixed size of filter is varied, the filter size is sufficient completely to fill a fixed cone of radiation, the edge of the diaphragm gives rise to secondary radiation through the partial transmission of the primary beam and the result of incidence of the primary beam upon the boundary faces of the cone of radiation. Experimental confirmation of the theoretical considerations was obtained except in the case of variation of incidence of the primary beam on the cone of irradiation, the deviation being attributed to defective diffusion. B. J. L.

OSCILLATIONS AND WAVES.

***2638. Thyratron Impulse Generator. B. G. Pressey.** *Journ. Sci. Instruments,* 15. *pp.* 163–171, *May,* 1938.—This paper describes a thyratron circuit for the production of voltages impulse of rectangular wave form whose time of duration and frequency can be varied over a wide range. The frequency range is 4–200 impulses per sec. and the time of duration of the impulse is variable from 3 to 100% of the time of a complete cycle. The maximum value of the magnitude of the impulse is 1000 V. Oscillograph records are given showing the wave form of the output voltage and illustrating the mode of operation of the circuit. A mathematical analysis of the circuit is also given and in conclusion the possibilities of extending the range of the generator are discussed. AUTHOR.

2639. Simultaneous Transmission and Reception of Electric Waves. F. Minaw and H. Antoun. *Gerlands Beitr. z. Geophys.* 53. 1–3. *pp.* 223–235, 1938. *In English.*—A method is explained for the simultaneous grid modulation of a valve transmitter and a valve receiver. Working on the same frequency and coupled to the same aerial, the transmitter can affect a distant receiver but not the neighbouring one, and the receiver can detect a distant transmitter but not the one close by. The method has several possibilities of application : (1) Measurement of the height of the ionosphere, (2) Prospection of ore and ground-water in dry regions, (3) Duplex telegraphy and telephony. AUTHORS.

2640. Reflection of Radio Waves from the Ionosphere. R. R. Bajpai. *Nat. Acad. Sci. India, Proc.* 7. 2–3. *pp.* 95–101, 1937.—Assuming that considerable reflection of radio waves takes place in the ionosphere at a place where electronic density is such that $d\mu/dN$ is very large, it is shown that the ordinary wave can be reflected from only one concentration of electrons while the extraordinary wave has in general three conditions of reflection for values of $p > p_H$. The author's experimental result that the penetration frequency difference between the extraordinary and the ordinary rays has on several occasions been observed to be only 0·14 Mc./sec. when the frequency of the incident waves was about 4 Mc./sec. is explained in the light of the theoretical results obtained. It is shown that reflection of radio waves from the ionosphere can take place not only from the places where group velocity is zero and phase velocity infinite but also from the strata where both the velocities are together zero. AUTHOR.

See also Abstracts 2355, 2559, 2626 and

2024B. Annual Variations in Upper Atmospheric Ionisation. K. Maeda, T. Tukada and T. Kamoshida.

2025B. Long Period Variations in the F_2-Region. K. Tani, Y. Ito and H. Sinkawa.

2026B. Occurrences in the Ionosphere during Aurora, Jan. 25th, 1938. F. Vilbig, B. Beckmann and W. Menzel.

2027B. Abnormal Effects in Ionosphere during Aurora. W. Dieminger and H. Plendl.

2028B. New Attachment Theory of Ionosphere. T. Tukada.

2029B. Comparison of Field Intensities of Short Waves Received Simultaneously from European Stations at Two Different Points in Japan. T. Amisima.

2030B. Maximum Usable Frequencies for Sky Wave Transmission 1933–7. T. R. Gilliland, S. S. Kirby, N. Smith and S. E. Reymer.

2031B. Application of Vertical Incidence Ionosphere Measurements to Oblique Incidence Radio Transmission. N. Smith.

2033B. Electromagnetic Field of Vertical Half-Wave Aerial. P. Rjasin.

2049B. Hertzian Waves. Electronic Oscillations in Triodes. E. Pierret.

2050B. Electric Oscillations. Resonance Phenomenon in Triodes. E. Pierret and C. Biguenet.

2062B. Electron Streams. J. Müller.

PHOTOELECTRICITY.

2641. Photo-E.M.F. in Semiconductors. B. Davydov. *Techn. Phys., U.S.S.R.* 5. 2. *pp.* 79–86, 1938. *In English.*—It is shown that the observed values of the photo-e.m.f. may be explained only on the assumption that semiconductors contain free charges of both signs, *i.e.*, both free electrons and " holes." In this case the problem leads to a system of diffusional equations, which are easily solved for weak illumination. If the resistance of the illuminated contact is high, the photo-e.m.f. for weak illumination is proportional to it. A considerable e.m.f. may appear only : (*a*) when the " dark " concentrations of the free electrons and " holes " are comparable, or (*b*) when the light creates free charges of a different sign from the thermal motion. If the contact resistance is not large, the photo-e.m.f. for weak illumination becomes a quadratic effect. The results obtained by Landau and Lifschitz do not always hold good. AUTHOR.

See also Abstracts 2437, 2564.

PIEZOELECTRICITY.

2642. Resonance in Crystal Beams of Sodium-Ammonium Seignette Salt. W. Mandell. *Roy. Soc., Proc.* 165*A*. *pp.* 414–432, *April* 14, 1938.—Experiments are made with longitudinal oscillations in crystal beams of sodium-ammonium Seignette salt. For a square beam a theory is deduced for the interaction of two longitudinal oscillations at right angles. These are considered as analogous to two coupled electrical circuits. If the natural frequencies in the two directions agree to within a small number of cycles per sec., the theory requires that resonance shall occur with the production of two new fundamental frequencies. This result is demonstrated experimentally. Experiments are also made to determine the change in wave-length with change in breadth and thickness. Theoretical calculations are made of the lateral contractions along the breadth and along the thickness, accompanying extensions along the length. The effect of thickness on the wave-length is found to be very small, in spite of the fact that the lateral contractions are large in two types of beams used. A change of breadth may change the wave-length by 20%. The experimental results for two types of beams agree closely with an empirical formula, while one type of beam behaves in an anomalous manner. AUTHOR.

See also Abstract 2573.

THERMOELECTRICITY.

2643. Reference Tables for Iron-Constantan and Copper-Constantan Thermocouples. W. F. Roeser and A. I. Dahl. *Bureau of Standards, J. of Research*, 20. *pp.* 337–355, *March*, 1938.—Tables have been prepared giving corresponding values of temperature and thermal e.m.f. at various temperatures from − 200 to 1000° C. (− 300 to 1800° F.) for iron-constantan thermocouples. Similar tables from − 200 to 400° C. (− 300 to 750° F.) for copper-constantan thermocouples, although not new, have been included for completeness. The temperature-e.m.f. relations embodied in these tables are such that (1) each can be reproduced with materials generally and readily available; (2) each is the same (within ± ¾%) as the temperature-e.m.f. relation of a large percentage of such thermocouples of that type now in use; (3) each is near the mean of the extreme limits of the temperature-e.m.f. relations for thermocouples of that type; (4) the table for iron-constantan is near the existing table most widely used, while the one for copper-constantan is the one most widely used; and (5) the constantan used with one element to reproduce one table can be used with the other element to reproduce the other table. This paper also gives (1) average values of the thermal e.m.f. of Cu, Fe which is generally available, and constantan against Pt, as a guide in selecting materials to yield any specified relation between thermal e.m.f. and temperature for thermocouples of these types and (2) the variations in thermal e.m.f. that might be expected between samples of these materials from the same lot and from different lots. AUTHORS.

See also Abstract 2563.